DOCUMENT RESUME

ED 244 796 SE 044 521

AUTHOR	Newton, David E.; Slesnick, Irwin L.
TITLE	Hanging on to the Wetlands. Book III.
INSTITUTION	Western Washington Univ., Bellingham.
SPONS AGENCY	Environmental Protection Agency, Washington, D. C.
PUB DATE	81
CONTRACT	EPA-68-01-6101
NOTE	237p.; For Books I and II, see SE 044 519-520.
AVAILABLE FROM	Western Washington University, Department of Biology, Bellingham, WA 98225 ($25.00 for set of 3: Books I, II, III).
PUB TYPE	Guides - Classroom Use - Materials (For Learner) (051)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Ecology; Environmental Education; Environmental Standards; Field Trips; High Schools; Learning Activities; *Marine Education; *Science Activities; Science Education; *Secondary School Science; Units of Study; *Water Resources; *Wildlife
IDENTIFIERS	Endangered Species; *Wetlands

ABSTRACT

This high school unit on wetland ecology consists of 12 activities and activity packets containing data sheets, activity sheets, flash cards, game cards, and other materials needed to complete the activities. The first activity is the text for a slide-tape show which provides an overview of the entire unit. Each of the remaining activities is then presented under five headings: (1) objective; (2) background; (3) activity; (4) summary; and (5) going further. The objective tells what students can gain from doing the activity. The background gives information about the subject matter of the activity and, when applicable, explains why the activity is important. The summary consists of several questions to be answered after the activity is completed. Going further is a section with suggestions for additional activities. Among the topics considered in the activities (which may be completed in any order) are wetlands environments (swamps, marshes, bogs), food chains, effectiveness of environmental action campaigns, effects of physical and chemical changes on wetlands, flood control, endangered species in wetlands, and section 404 of the Clean Water Act of 1977. (JN)

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Hanging on to the Wetlands

Book III

SE044521

Hanging on to the Wetlands

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This material was prepared with the support of the Environmental Protection Agency, Contract #68-01-6101. Any opinions, findings, conclusions or recommendations expressed in these publications are those of the authors and do not necessarily reflect the views of EPA.

Cover art by Ron K. Sorensen

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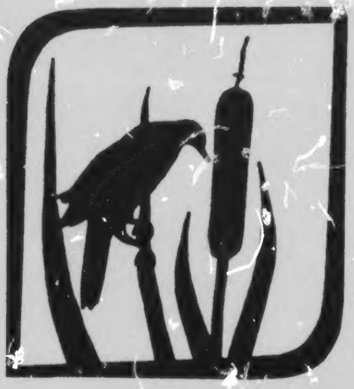


An Introduction to the Student

Hanging on to Our Wetlands is a unit on ecology. You will learn about a special kind of environment known as a wetland. This unit consists of 12 activities. Each activity is introduced in this book. Activity materials are contained in the 12 pockets of the canvas frame.

Activity #1 is a slide/tape show. This program will give you an overview of the entire unit. In the first segment you will find out what a wetland is. Then you will see examples of different kinds of wetlands. Pictures of plants and animals of the wetlands will introduce you to the special characteristics of wetlands. The next segment of the program explains the importance of wetlands. Then a series of slides describes what happens to wetlands after humans change them. Finally the show considers the actions people take to protect and preserve wetlands.

After the slide tape show you will select activities to do. The eleven remaining activities are numbered in order of their introduction in the slide/tape show. However, you do not have to do the activities in any particular order. You might choose to do Activity #8 first and Activity #3 second. But before you decide which activity to do first, look over all of the activities. They are described in this book.

Each of the eleven activities is presented under five headings: OBJECTIVE; BACKGROUND; ACTIVITY; SUMMARY; and GOING FURTHER. The OBJECTIVE tells you what you can get out of doing the activity. The BACKGROUND gives you some important information about the subject of the activity. This section may also explain why the activity is important. The ACTIVITY tells you what you will be doing and how you might go about it. The SUMMARY section consists of several questions. You should be able to answer these questions after you do the activity. GOING FURTHER is a section with ideas about more things to do. This section is for students who find the activity especially exciting.

The twelve pockets in the canvas frame contain the guidesheets, references, and a few of the materials you will need to do the activity. You will find that some of the materials for activities will have to be gathered from school or home. Books for additional reading will have to be found in a library.

Near the close of your unit study you may want to watch the slide/tape show again. After doing some of the wetland activities, a second showing may impress you more than the first.

1

An Introduction to Wetlands

1. What's going on here?!?

2. Some big changes are being made in this marsh. Land is being filled in for new homes.

3. And this marsh is being drained for new farmland.

4. Plant and animal life are being changed. Spraying will kill mosquitoes in this marsh, but it may affect other organisms, too.

5. Sometimes changes are not planned. Oil spills damage marshes and the organisms that live there.

6. Some people deliberately pollute on a massive scale.

7. Our marshes, swamps, and bogs are in danger. Many of them are being changed. But do we always know what we are doing when we make these changes? Do we know what will happen when the swamp or marsh is no longer there?

8. These are difficult questions . . . but important ones. Debates are going on all the time . . . all over the United States today . . . about the best use of wetlands.

9. This slide program is about our wetlands--our swamps, marshes, and bogs--and about the ways in which they can be used.

10. You'll learn that some people want to leave wetlands just as they are . . .

11. . . . and others want to change them for one reason or another.

12. These are questions you should think about. They are your wetlands, too! There may be a time in your life when you will want to decide what to do about a wetland area.

13. To do that, you will need a lot of information. You should know what a wetland is, what kinds of wetlands there are, what organisms live in a wetland, how wetlands benefit humans, and how people change wetlands.

14. The term wetland refers to any area that is under water most of the time. The soil in a wetland is saturated with water enough of the time to permit the growth and reproduction of certain typical "wet-soil" plants and animals.

15. Some wetlands, such as this swamp, are dry for part of the year . . .

16. . . . and under water for the rest of the year.

17. A few cattails along a roadside is not the basis for a wetland.

18. Nor is a river or a lake regarded as a wetland.

19. It's often difficult to decide what a wetland is. The best way to make up your mind is to look at the organisms that live there.

20. If you see plants and animals such as the cattail . . .

21. . . . moose

22. . . . venus fly trap

23. . . . Eastern painted turtle

24. . . . water lily

25. . . . sandhill crane

26. . . . or pintail duck . . . you are probably looking at a wetland.

27. You know wetlands by many names: marshes, swamps, bogs, potholes, sloughs.

28. Freshwater marshes are by far the most common type of wetland. They make up over 90 percent of all wetland area in our nation.

29. A freshwater marsh may look like a shallow lake. The water is seldom more than a few feet deep.

30. Or you may not even be able to see the water because of all the plants that live there. Freshwater marshes are fed by springs, streams, rainfall, runoff from nearby lands, and groundwater.

31. Soft-stemmed plants like grasses, sedges, and rushes are the most common marsh plants.

32. Saltwater marshes occur along much of our ocean coastline. They often form at the mouth of rivers.

33. The level of water in a salt marsh rises and falls as the tide comes in and goes out.

34. Plants that live in salt marshes have made a difficult adjustment. Normally land plants don't live well in salt water. But over many generations, some land plants like this mangrove have adapted to this normally harsh environment.

35. Swamps are found mostly in the southeast and the northern midwest. They are under water during winter, spring, and fall. But they may dry up completely during the summer.

36. Plants that live in swamps are those best adapted to these conditions. Woody plants like maples, cedars, ash, and cypress trees are able to survive in both very damp and fairly dry environments.

37. Bogs are unusual because they generally have no outlet. Water that gets into them just stays there until it soaks into the ground or evaporates. The water they contain is acidic, low in oxygen, and poor in nutrients. Bog plants have developed ways of surviving in these special kinds of surroundings.

38. This is just a brief introduction to some types of wetlands. In Activity 2, you will have a chance to study marshes, swamps, and bogs in more detail.

39. These categories of wetlands seem very different. Is there anything about them that is the same for bogs, swamps, and marshes? You could probably think of at least two things: the water they contain and the soil of which they are made.

40. The water in wetlands varies a great deal. It can be salty or fresh; warm or cold; acidic or neutral; next to the ocean or inland. About the only common feature of water in all wetlands is that it tends to be quite shallow.

41. Of course, the most important thing about the water is that it's there. It doesn't show up only after a rainstorm. The land is soaked with water for most of the year. And that makes a lot of difference as to the kinds of plants and animals you find there.

42. Wetland soil has one common characteristic, no matter where you find it. It always has the ability to hold water well. Conditions in a wetland--plant and animal life, weather and climate, and geological conditions--tend to result in the production of muck, moss, and decayed organic matter. These materials tend to have high capacities for holding water, somewhat like sponges.

43. All in all, wetlands differ a lot from one another. One way to notice those differences is to study the organisms that live in a swamp, a salt marsh, a freshwater marsh, and a bog. Activity 3 will help you to prepare for a field trip to a wetland near you to do this.

44. You'll soon discover why we distinguish wetlands from each other on the basis of the organisms that live there. A swamp, a marsh, or a bog has its own special community of plants and animals. Over many generations, each type of organism has become adapted to the special conditions in that wetland. Can you see why the Hawaiian stilt is adapted to wetland life?

45. Plants that grow in wetlands have adapted in a number of ways. Over many generations of plant populations, there was survival value in certain plant characteristics, such as the water-swollen arms of the salt-tolerant plant salicornia.

46. For another population, mud-anchored roots and surface-floating leaves and flowers had survival value. The marsh marigold is an example of this.

47. For still others, living beneath the water and using gases dissolved in water has been the most efficient form of adaptation.

48. Bog plants provide more examples. Bog water contains few of the nutrients needed by plants. So, bog plants have developed other ways of surviving. In the sundew, sticky beads of moisture at the tips of spines capture insects. The digestion of these insects produces the nutrients needed by the plant.

49. Similarly, the sweet nectar of the pitcher plant attracts insects. When insects enter the plant to feed on the nectar, they are trapped in the hairy, sticky surface of the plant. As with the sundew, the pitcher plant obtains the nutrients it needs in this way.

50. Other plants on the bog are members of the Heath family. They grow well in acidic water and soil. And that is exactly the environment in a bog. The cranberry is a member of the Heath family.

51. Plants in saltwater marshes have adapted to special conditions there, too. Spartina, for example, has special cells that secrete excess salt through the stalk.

52. The glasswort, which grows abundantly in some salt marshes, has developed a different form of adaptation. The cells in a glasswort hold large amounts of water. This provides them with a high tolerance for salt.

53. Animals that live in wetlands have also adapted to their environments in a variety of ways. Marshes are good homes for animals because they produce a lot of food and provide shelter. During a visit to a freshwater marsh you are likely to see . . .

54. animals building their homes

55. . . . laying their eggs

56. . . . and using the water as a means of transportation.

57. A cypress tree is well adapted to swamp life. A mature tree can live almost indefinitely with its roots under water. But a cypress seedling will take root and begin to grow only on dry land.

58. And few animals have adapted to the swamp as well as the anhinga. It nests in the many trees found in swamps. That's not unusual for a bird. But the anhinga gets its food from under water! Its streamlined body is well suited for fast dives under water. And its sharp, pointed bill is just right for spearing the fish it takes for dinner. We've caught this anhinga, drying its wings, after its latest meal.

59. We'll never understand wetlands by studying organisms one at a time, however. For every plant and animal in a wetland depends on every other plant and animal. The way that organisms relate to each other is called a food web. You'll learn more about food webs in Activity 4.

60. Humans benefit from wetlands in many ways. For example, some countries depend heavily on wetland crops, like this rice, for their food supply.

61. Marshes and swamps are a major breeding ground for fish and shellfish. Shrimp, menhaden, and striped bass may be taken at sea. But they spend an important part of their life cycles in a salt marsh.

62. The prairie pothole region in the northern Plains states is the most important breeding area for ducks in North America.

63. A large, healthy duck population is important to many groups of people. Photographers and painters, bird watchers, hunters, and nature lovers in general all want to maintain these breeding grounds.

64. In Activity 5, you will learn how to study data and find out about the productivity of wetlands.

65. We never see many of the benefits of wetlands. For example, we're just beginning to find out how good they are as filtering systems. A lot of our waste materials end up in bogs, swamps, and marshes. These wetlands use and store some of those wastes so that they don't get into our water supplies.

66. But there is a limit to the amount of pollution a wetland can absorb. Uncontrolled and unwise use of wetlands as dumps can damage and destroy them. Perhaps you can predict the kinds of damage that would be produced by this kind of pollution.

67. In Activity 6, you'll find out how too much pollution affects a water community.

68. Wetlands are also valuable in controlling floods. We have learned about this the hard way. The more wetlands we have paved over, the worse flooding problems have become. In Activity 7, you'll see why this is.

4

69. A lot of people don't care what value wetlands have in dollars. They just think that they are beautiful spots in which to be. They are pleasant places to go fishing . . .

70. . . . boating

71. . . . bird-watching

72. . . . or just sitting and thinking

73. Wetlands are some of the most beautiful places on earth. That's certainly an excellent reason for keeping them just as they are.

74. The beauty of wetlands has inspired some wonderful poetry, stories, and descriptions. In Activity 8, you'll read some of these and create one of your own. You'll then have a chance in Activity 9 to find other ways of expressing how you feel about the wetlands.

75. Not everyone thinks the wetlands are so wonderful, however. Many people can think of other ways to use them. It's common for farmers to fill in or drain swamps, marshes, and bogs. Wetlands contain very rich soil, and they make good farmland.

76. Growing more food is certainly a major problem for our nation and the rest of the world. Should we really keep a marsh just the way it is when it could be a productive cornfield?

77. And our desire to live near the water means that we have to change wetlands, too. Over half of our population lives within a hundred miles of the ocean or one of the Great Lakes. The land closest to the ocean or lake is often a swamp or marsh. If you want a house on the ocean or lake, you may have to fill in the wetland. What reasons can you think of either for or against doing this?

78. Changing a wetland is often a huge project. We may want to build a new road . . .

79. . . . deepen a channel for boat traffic

80. . . . or drain a marsh to get rid of mosquitoes.

81. Projects like these can change the whole face of the wetland and adjoining land.

82. Whether we plan changes or not, we can do some terrible damage to organisms. How many stories do you know about endangered species? Humans come in and take over the feeding grounds of an animal. In competition like this, humans nearly always win. In some cases, we've worked hard to keep an organism from dying out. The whooping crane may be one of our success stories in this respect.

84. Until the last few years, no one thought much about "saving the wetlands." Changing them into farmlands, highways, and housing developments was almost considered the right thing to do. Now we're not so sure. More people are asking whether we should leave some of our wetlands the way they are

85. The federal government has begun a campaign to save some of our wetlands. It requires that people think carefully about their wetlands. Each time a change in wetlands is planned, the government expects people to measure benefits against losses. This is difficult since we seldom know how to compare short-term and long-term gains and losses.

86. These ideas first became law in the Amendments of the Clean Water Act in 1977. One provision of that law was that anyone who wanted to change a wetland had to get approval. A "Section 404" permit is now needed by most people who want to drain, dredge, fill, or otherwise change a swamp, marsh, or bog. In Activity 11, you'll learn more about "Section 404" permits.

87. There will probably be times in your future when you will have to think about the fate of some wetland. You will have to choose between beavers and soybeans; between cattails and farmlands; between great blue herons and a new highway.

88. How will you make up your mind? Activity 12 will help you think about this question. You'll have some practice in making that kind of decision. So will the other activities in this package.

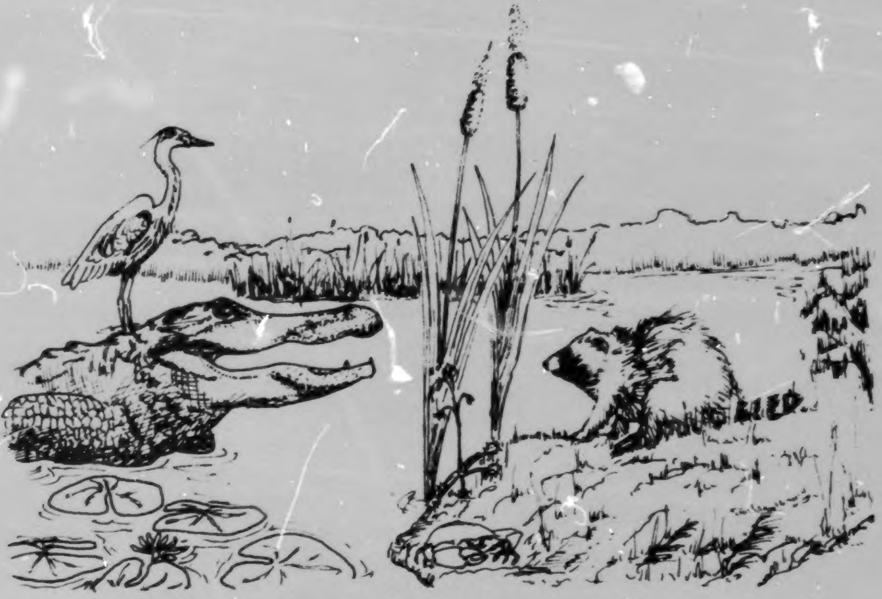
89. As you work through them all, try to keep in mind your overall goal in this module: Developing the skills you will need to answer difficult, confusing questions about the place of wetlands in your future.

2

Swamps, Marshes, and Bogs

OBJECTIVES

Swamps, marshes, bogs. Alike, yet different in many ways. In this activity, you'll find out how four major kinds of wetlands are different from each other By sorting a mixture of 40 pictures of plants, animals, and landscapes, you'll learn to recognize the special characteristics of these wetlands.



BACKGROUND

There's something out of place in this picture. Can you figure out what it is? Wetlands are alike in some ways. In all of them, for example, soil is saturated with water at least part of the year. But swamps, marshes, and bogs differ from each other in some important ways. The water in salt marshes, for example, is brackish (salty), a condition that most plants can't tolerate. To live in a salt marsh, a plant has had to adapt to an unusual environment. Most plants that flourish in a freshwater marsh would not survive in a saltwater marsh.

Swamps contain many tall trees with thick foliage. A marsh plant that needs full sunlight would not do well in a swamp. Bogs usually have no inlet or outlet.

The water found there is sour (acidic) and lacking in nutrients such as oxygen and nitrogen. Only very specialized plants (for example, those that eat insects) can grow in bogs.

In general, we can say that each kind of wetland is a very special community. We use the term "community" because the plants and animals that live there depend very much on each other. We say "special" because the members of the community have learned to adapt to those conditions of soil and water that exist in a saltwater or freshwater marsh, a swamp, or a bog.

THE ACTIVITY

1. To do this activity you will need to become familiar with the characteristics of each type of wetland. Brief descriptions of each are contained in the book, Our Nation's Wetlands. You can also use an encyclopedia and any science books your teacher has available.

2. The activity consists of a set of twenty four pictures of wetland organisms. Your job is to sort these into four piles: those that belong in a (1) saltwater marsh, (2) freshwater marsh, (3) swamp, and (4) bog. You should end up with six pictures in each group.

3. When you've identified the four groups, choose one to continue working with. Arrange the pictures in this group in some logical fashion. Then make a background for them. Include soil and water conditions that are appropriate for this wetland area. You should end up with each organism in that part of wetland where it belongs. Your final product can be arranged as a large poster, a bulletin board display, or a diorama.

SUMMARY QUESTIONS

1. Name six organisms that are characteristic of each type of wetland.

2. Choose a wetland organism that could not survive in a swamp; in a bog; in a salt marsh; in a freshwater marsh. Explain why in each case.

3. In the sorting activity, were there any organisms that could have gone into more than one wetland group? If so, name it (or them). What does this tell you about

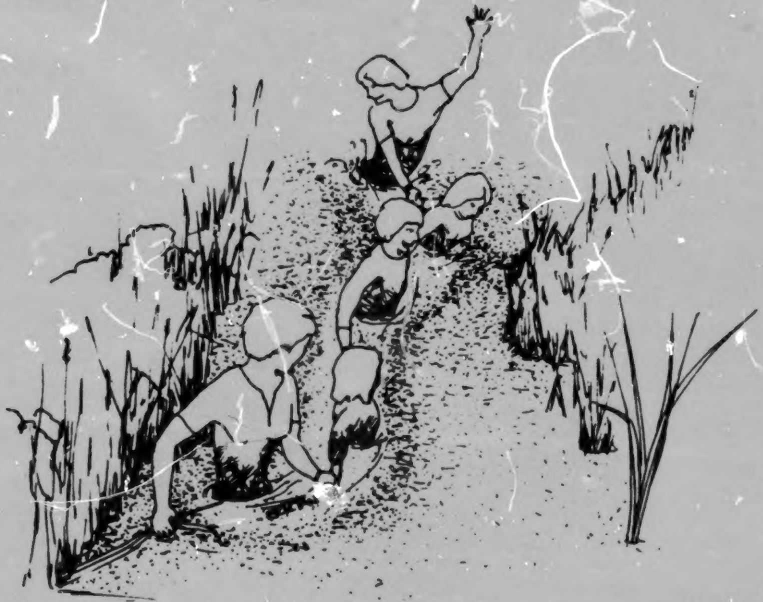
the survival chances of this organism? If there was no organism that fits this description, what does that tell you about the plants and animals used in this activity?

3

The Field Trip

OBJECTIVE

In this activity you will investigate a wetland. There you will carry out a study of one feature of this special environment. Your study should increase your knowledge of ecology and your skill in research.



BACKGROUND

Wetlands are environments in which certain kinds of living and nonliving things are found together. The organisms depend on one another for food and shelter. The organisms also depend on water, the soil, the sunlight, and the temperature in the wetland. The wetland is a delicately balanced system. To understand the system of a wetland is to know all the parts and how the parts work together.

It is difficult to study all of a wetland at one time. The whole system is complex. The usual field study of a wetland involves three major steps.

1. The student looks over the whole wetland.

2. The student carries out a special study of one part of the wetland. The part studied may be the water, the soil, the birds, or the floating plants.

3. All students put their studies together. By listening to, reading, or looking at other students' reports, all students learn about the whole wetland system.

THE ACTIVITY

In Activity Packet #3 you will find an envelope labeled FIELD TRIP TASK CARDS. Inside the envelope are 13 printed cards. Each card describes one task to carry out on a field study trip to a wetland. Read over the cards. Choose one card you are most interested in using. The subjects on the cards are:

1. Scavenger Hunt in a Wetland
2. Use a Key to Identify the Kinds of Wetlands and Deep Water Habitats
3. Wetland Plant Collection
4. Plant Map
5. Wet Pets
6. Wetland Soil
7. Temperature Map
8. Bird Watching I; Identifying Birds
9. Bird Watching II; Special Bird Study Projects
10. Photography
11. How Fast Does Duckweed Reproduce?
12. Mud
13. Succession

Carry out the field trip task you selected.

SUMMARY

Report the findings of your study in one of the following ways:

1. Prepare a written report. Give it to your teacher. These reports may be exhibited on the bulletin board, or made into a book.

2. You may decide to exhibit the results of your field study in a display of things collected, pictures taken, or charts drawn.

3. You may choose to make an oral presentation. Certainly recordings of wetland sounds or the collection of information that can be discussed by the whole class requires oral presentation.

GOING FURTHER

1. Carry out a second field trip task.

2. Carry out your wetland study in a second wetland.

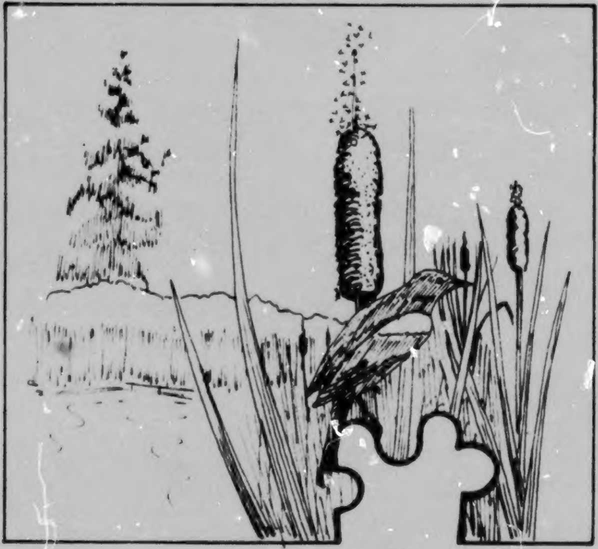
3. Think up your own investigation to carry out in a wetland. Carry out the activity. Report your findings.

4

Puzzling Out a Food Web

OBJECTIVE

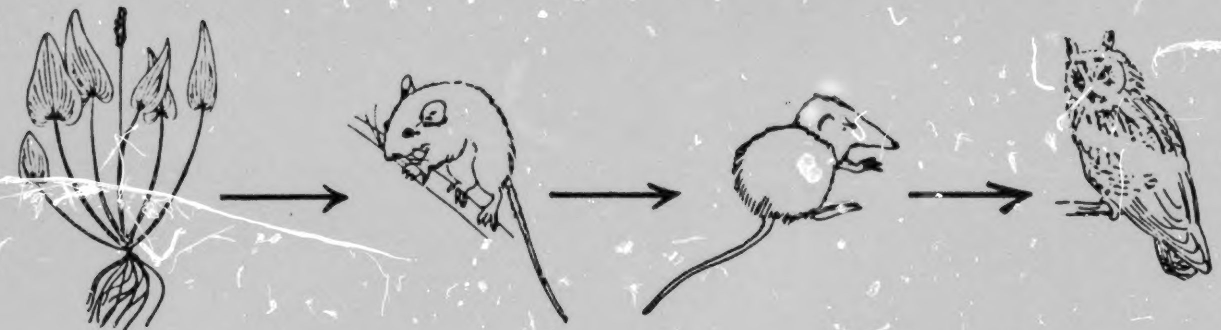
A wetland is like a puzzle. Every part fits in some way with every other part. In this activity you'll study a wetland puzzle: food webs. Food webs are patterns that show who eats whom in a wetland. You'll find out what happens when one part of the puzzle is removed.

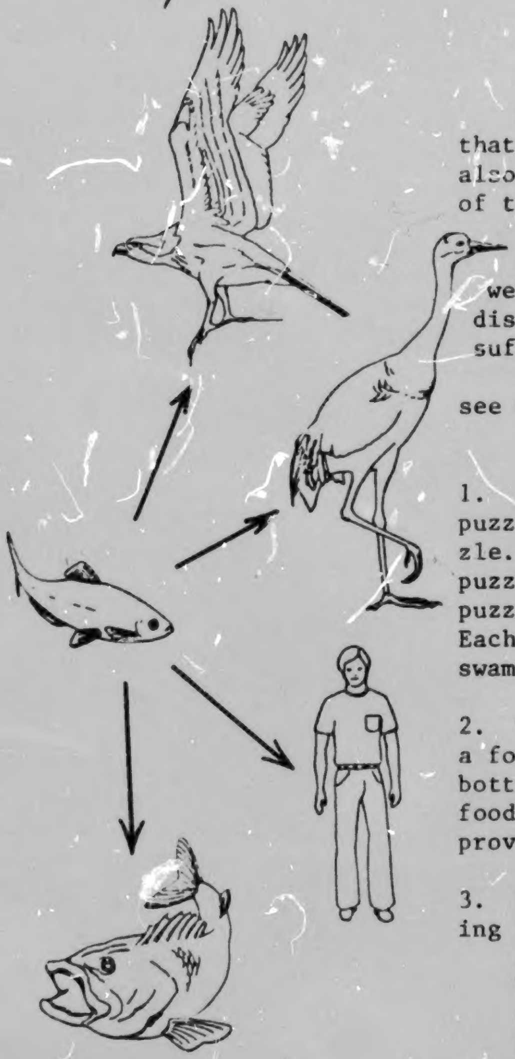


BACKGROUND

This puzzle wouldn't be much fun to work. With one piece missing, we'd never know exactly what the picture was. If this were a real wetland, a "missing piece" would be a real problem. It would be more than "not much fun."

The organisms in a wetland are dependent on each other. For example, a garter snake might depend on frogs for dinner. In turn, a red-tailed hawk might feed on garter snakes. A sequence that shows who eats whom is called a food chain. Here is a typical food chain for a marsh:





Eating patterns are really more complicated than that. Besides the mouse, the vole, rabbit, and muskrat also eat plants. A completion description of all parts of the wetland puzzle is known as a food web.

Removing an organism from a food web can cause dramatic changes. What would happen in the food web, pictured on the left, if an organism were to disappear forever? Who would benefit? Who would suffer? How would the wetland change?

In this activity, you'll construct a food web and see what happens when parts of it are removed.

1. In Activity Package #4 you'll find four hidden word puzzles. The top half of each sheet contains the puzzle. At the bottom are the words to look for in the puzzle. All the words are spelled out correctly in the puzzle, left to right, top to bottom, and diagonally. Each puzzle contains a food web for one kind of wetland: swamp, saltwater marsh, freshwater marsh, or bog.

2. When you've found all the words in the puzzle, make a food web from those words. Cut out the terms at the bottom of the puzzle and arrange them to give a correct food web for this kind of wetland. Use the arrows provided in the envelope.

3. Finally, remove one at a time, each of the following from your food web:
    a. a second-level consumer
    b. a first-level consumer
    c. a producer
    d. a decomposer

If you don't know what these terms mean, refer to the Glossary.

In each case, tell what you think would happen in the food web as a result of taking out each type of organism. You can write your answers on the Data Sheet.

SUMMARY QUESTIONS

1. Define a food web.

2. Draw the parts of a food web for any one wetland area.

3. Is it possible for an organism ever to be removed entirely from a food web? Can you think of a specific example? List all the things that could happen to the rest of the web if an organism disappears completely.

GOING FURTHER

1. Design and make a poster or bulletin board display from your food web. Find or make pictures of the wetland organisms in your web. Then arrange them in some attractive and accurate way.

2. "The more diverse an environment is, the more likely it is to survive if it is disrupted." Let's test that idea in this way: Suppose two wetland areas are close to each other. In one, there are six populations of organisms arranged in a food chain. Draw this chain. In the other, there are 12 populations of organisms in a food web. Draw this web. Now, a first-order consumer becomes extinct in each. What effect will this have on the organisms in each wetland?

3. Pomacea paludosa is a freshwater snail that lives in the Everglades. It is endangered. Find out (a) why it is endangered, and (b) what effect this has on the Everglades food web.

5

Measuring the Productivity of Wetlands

OBJECTIVE

How does the production of food by green plants in a salt marsh compare with the productivity of an ocean reef, a desert, or a sugar cane field? In this activity you will work with data showing how much food is made in various ecosystems. You'll find out why so many ecologists see the wetlands as enormous dinner tables for animals.

BACKGROUND

We know that plants are chemical factories in which solar energy is stored in the bonds of carbon compounds by the process of photosynthesis. The amount of energy a plant stores in its tissues can be expressed in Calorie units. A banana has on the average 100 Calories (note that the capital letter C is used for this energy unit; when using the lower case "c" we are speaking of a much smaller amount of energy:

1 Calorie = 1000 calories = 1 Kilocalorie

Plants vary in their ability to covert solar energy into food energy. Some efficient plants store many Calories per gram of tissue. Some inefficient plants store relatively few Calories per gram. Many in-between types of plants also are found. Highly efficient plants are important to food webs since they provide lots of energy for consumers, including humans.

Ecologists are interested in finding out now much food is manufactured by plants in various types of ecosystems. Plants are the producers, and we need to know how much food they produce. Productivity is a measure of how much food is produced in a certain area in a certain period of time. The most accurate way to determine productivity is to find out how many Calories of energy are stored by plants in one square meter or area over a period of one year. Since measuring Calories is difficult, ecologists often record yearly changes in dry weight of the plants in a square meter. They then use this weight change to compare the productivities of different ecosystems. (To know how many new Calories have been added during the year, convert grams of plant into Calories by using the "rule of thumb" expression, one gram of plant equals about 4 Calories.)

An ecologist may determine that lawns in Columbus, Ohio, produce 600 grams of new grass (dry weight) for each square meter of surface area in one year. She would say that the productivity of lawn is 600 g/m^2/year. (About how many Calories does this represent?) Productivity would, of course, vary with the kind of grass, amount of rainfall, addition of fertilizer, and winter temperatures. And, probably, productivity of lawns in Columbus would be expected to be less than lawn productivity in Miami, Florida, and greater than lawn productivity in Fairbanks, Alaska.

Wetlands are well known for their natural high productivity. Energy trapped by wetland plants is essential for the survival of animals that depend on wetlands for food. The greater the productivity of wetland plants, the larger the number of animals that can benefit from the wetlands.

THE ACTIVITY

This activity begins with a simulated research study in a salt marsh. In part 1 you have just harvested ten (10) different one square meter samples of salt marsh grass from various locations during the late fall season. You will compare the weights of these samples with the weights of the plants at the start of the growing season, then you can determine how much food (production) was made by the salt marsh grass in one year. You will calculate the average productivity of the salt marsh in g/m^2/year and then convert your answer into energy units (C/m^2/yr). In part 2 you will have an opportunity to compare your value for productivity in a salt marsh with productivity of other ecosystems. In part 3 you will apply your knowledge of productivity to the important role of various ecosystems in meeting the world's food needs. Guide sheets for this activity are located in Activity Packet #5.

SUMMARY QUESTIONS

1. The productivity of a water hyacinth population is rated at 11,000 C/m^2/yr. What is the meaning of this value?

2. How does productivity of water hyacinth compare with the productivity of a tropical forest, a desert, a corn field, and open ocean?

GOING FURTHER

1. Not all the solar energy that falls on an ecosystem is converted into food calories by plants. How many Calories are reflected back into space or warm rocks, water plants, and other objects? What is the efficiency of the plants of the ecosystem? Are the plants of every type of ecosystem equally efficient in capturing solar energy? Answers to these questions can usually be found in ecology textbooks.

2. Suppose that the productivity of a fresh water marsh is 7400 C/m^2/yr. And suppose the plants of the marsh are eaten by zooplankton and bloodworms, which are eaten by insects, which are eaten by sun fish, which are eaten by bass, which are eaten by humans. How many of these 7400 C/m^2/yr are the humans' share?

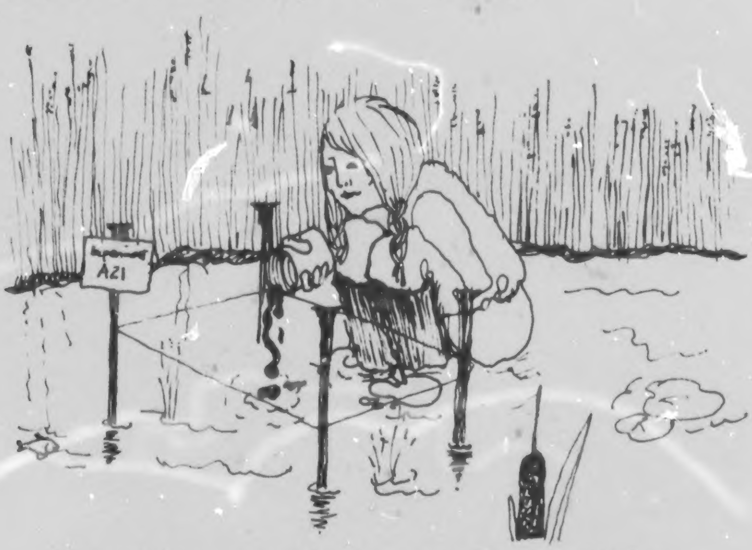
3. What happens when the productivity of coastal salt marshes is reduced? Where are the effects of reduced food productivity felt?

6

Experiments in Wetland Ecology

OBJECTIVE

How do chemical and physical changes in the environment affect a biological community? In this activity you will have the opportunity to set up your own experiment to test the effects of environmental changes on the make up of communities.



The environment of every organism includes physical, chemical and biological factors. Chemical factors in the environment of a wetland organism includes pH, salinity, oxygen, carbon dioxide, phosphates, nitrates and heavy metals. The physical environment of a wetland organism includes temperature, light intensity, length of day, and stillness of the water. The biological environment includes the number of individuals of the same species (population), the different species (diversity), and the spacing of individuals. All the organisms together in a given environment make up a biological community.

The make up of a biological community depends on specific physical and chemical factors in the environment. Should only one factor change (a slight change in temperature or pH) the effect may be seen in changes in population size of one or more species. Cold winters, the spilling of sewage, or heavy rains, are known to affect the make up of biological communities.

Pollution often has dramatic effects on the make up of biological communities. Heat is a physical pollutant that can eliminate intolerant species. An oil spill on a wetlands might also create new conditions for survival which will cause changes in the numbers and kinds of organisms.

THE ACTIVITY

Design an experiment to find out what happens to an aquatic wetland community when you change one physical or one chemical factor, such as adding a pollutant. Activity Packet #6 includes an illustrated guideline on how to begin your experiment. (The slide tape uses pollution as an element of this activity.)

SUMMARY QUESTIONS

1. What changes in the sizes of populations occurred as a result of the factors you chose to vary?

2. What changes in the make up of biological communities you know have been caused by humans changing environmental factors?

3. How can you tell when a biological community is up graded or down graded as a result of the changing of an environmental factor?

GOING FURTHER

1. What would be the effect of adding a new acquatic organism to your biological community?

GOING FURTHER

1. What would be the effect of adding a new aquatic organism to your biological community?

2. What are some other research techniques for studying the effects of pollution on biological systems?

7

Keeping Floods under Control

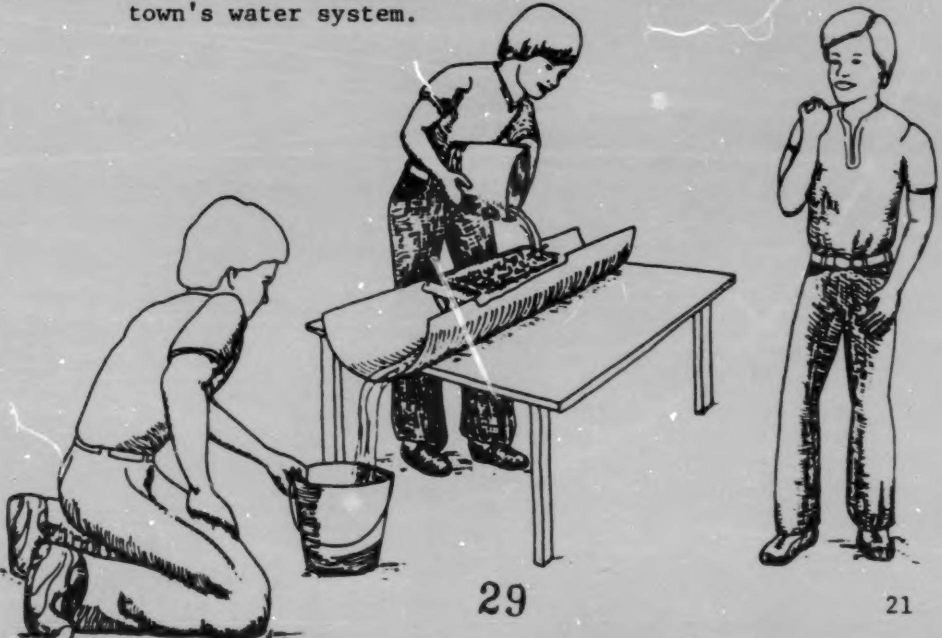
OBJECTIVE

Flooding is a major problem in many parts of the nation. As humans change the environment, they often increase flood problems. In this activity you'll study the history of flood patterns on an important U.S. river. You'll see how the destruction of wetlands has contributed to making flood problems worse in the Boston area.

BACKGROUND

It's taken us a long time to see how useful wetlands can be. For many years it seemed to make more sense just to fill them in, dredge them, or drain them. Then the land could be made "useful" for agriculture, shipping, or home-building.

We're just beginning to see that wetlands help us in ways we never thought about. For example, we now know that wetlands are a good purifying agent. Water that is polluted by industrial wastes and sewage is made clean as it passes through wetlands. Wetlands can also be helpful in maintaining a community's water supply. Water that might otherwise run off into a river or stream is captured in a swamp or marsh. It soaks into the ground and can be recaptured by the town's water system.



The role of wetlands in helping to control floods is another recent discovery. Areas in which wetlands have been destroyed are experiencing heavier flooding than they had seen earlier in history. Flooding is often less in towns only a few miles away that have saved their marshes and swamps.

In this activity you'll review the history of an area in which wetlands have been partially destroyed. You'll see what problems of flooding this has produced. Finally, you'll have a chance to recommend what this area can do to improve its flood protection in the future.

THE ACTIVITY

1. Activity Packet #7 contains the following worksheets:

   a. Twelve maps of the Charles River region in Massachusetts

      4 for the year 1890
      4 for the year 1930
      4 for the year 1960

   b. Nine elevation sketches for cities along the Charles River

      3 for the year 1890
      3 for the year 1930
      3 for the year 1960

   c. Information on the horizontal spread of floods for three major flood years: 1890, 1930, and 1960.

   d. Information on the highest level reached by flood waters for three major flood years: 1890, 1930, and 1960.

2. Your first task is to draw in the flood patterns for each of the three flood years. You have a map for Day 1, Day 2, Day 3, and Day 4 of the flood for each year. You will end up with a total of 12 maps. Get the information you need from Data Sheet 1.

3. Next, show the maximum flood height for each of the three cities during each flood. Use the Elevation Sketches for this. The information you need is on Data Sheet 2.

4. Prepare a recommendation for future flood control action in the Charles River basin.

SUMMARY QUESTIONS

1. What relationship do you see between flooding and the amount of wetlands in an area? Between urban development and flooding?

2. Does the construction of levees and dikes help in cases like this one? Why or why not?

3. What property (or properties) of wetlands makes it possible for them to control floods? How could you check your answer experimentally?

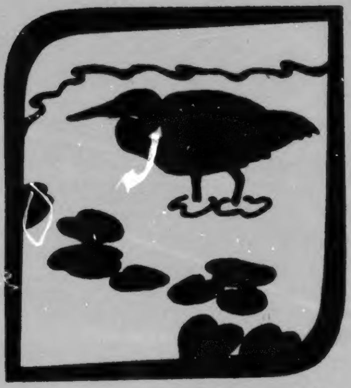
GOING FURTHER

1. There must be something about a wetlands that lets it control flooding. What do you think that factor might be? Design an experiment to test your ideas. The sketch at the beginning of the "Background" section should help. Put together the data you collect in some attractive form and present it to the class.

2. Is there a flooding problem in your community? If so, has the destruction of wetlands been a factor? If not, have wetlands protected your community from severe flooding. Collect as much information as you can about flooding in your area. Then write a Case Study like this one for your own town.

3. Observe a local shopping center parking lot during a rainstorm. Where does the water go that lands on the parking lot? Where would it go if there were a marsh here instead?

4. Suppose it rains one inch during a storm. A shopping center parking lot measures 1000 feet wide and 2000 feet long. Calculate the amount of water that lands on the parking lot in cubic feet; in gallons. As a comparison, calculate the amount of water your bedroom would hold if it were filled from floor to ceiling.



8

A View of the Wetlands

OBJECTIVE

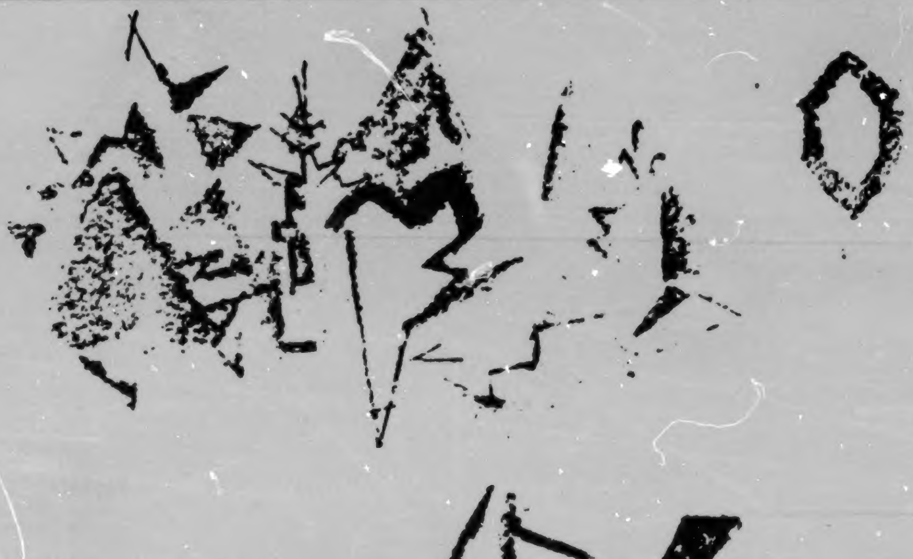
There are many ways of describing wetlands. We tend to use verbal definitions first. But there are other ways to describe wetlands: pictures, song, dance, and pantomime are other ways. In this activity you'll use some nonverbal ways to describe wetlands.

BACKGROUND

What does a wetland look like to you? For a scientist, a swamp or a bog calls forth expressions like mixing zone, ecological niche, and aquatic biota. But not everyone sees nature in the same way. To Joyce Kilmer, for example a tree was something whose

> ". . . hungry mouth is pressed
> Against the earth's sweet flowing breast.
> A tree that looks at God all day,
> And lifts her leafy arms to pray."

And to artist John Marin, this is what trees look like:



So which description of a tree is "best"? Which one is "correct"? Those are not terms we should try to use here. A poet, an artist, and a scientist all look at a tree from different standpoints. No one method of describing the tree is any better or more correct than any other method. Each is a particular person's attempt to tell us what "a tree" means to him or her.

THE ACTIVITY

In this activity, you'll explore some nonverbal ways of describing a wetlands.

1. You'll need to begin by visiting a wetland. You should go in person if possible. But if you can't do that, then "visit" by looking at photographs. Books from the library should help. If you actually visit the wetland in person, try to be aware of as many sensations as possible. Be alert not only for visual images, but also for sounds, feelings, odors, and moods in the surroundings. If you limit your "visit" to books, this will be more difficult. Perhaps it will help if you close your eyes and try to image a wetland scene, based on what you have read.

2. Next, create your own wetland masterpiece: a painting, charcoal sketch, paper-folding piece, sculpture, song, dance, or whatever. No one can give you many directions at this point. A piece of art is a reflection of your feelings, your emotions, and your imagination. Let your creativity run free. Produce a piece of art that contains your understanding of the wetlands.

SUMMARY QUESTIONS

1. Make a list of words that describe your feelings about the wetlands.

2. In what ways is your wetland art different from the scientific description that could be given for this same area? In what situations would the scientific description be useful? In what situations would your art be useful?

3. Some people believe that wetlands should be preserved "just because they are beautiful." After this activity, how do you feel about this argument?

GOING FURTHER

What will you do with the art you've made for this project? One possibility is to have an art show. Collect everyone's work and find an interesting way to display it. Then invite parents and friends, or other classes to observe your art show.

9

Tell Me About the Wetlands

OBJECTIVE

People have been writing about swamps, marshes, and bogs for a long time. In this activity you'll read some of those accounts. They range from news reports to literature to scientific descriptions. Then you'll have a chance to write about a wetland in a format you like best.

BACKGROUND

"Slowly he pushed his way through the bog. He was up to his knees in water. He tried to ignore the water snake gliding through the lily pads on his left. Suddenly, something grabbed his ankle. 'An alligator!' he thought and began to move as fast as he could through the muddy waters of the bog."

People write about wetlands for different reasons. Scientific reports try to give accurate information about swamps, marshes, and bogs. In works of literature, a wetland scene may be used to add mood or atmosphere. News reports may concentrate on the economic, social, or political importance of wetlands.

Whatever the purpose in writing about wetlands, we should expect one thing: accuracy. There's no reason to make up characteristics that a swamp, marsh, or bog really doesn't have. What do you think of the short selection that begins this section? Is it a good description of a bog? Why or why not? (See summary question #2.)

In this activity, you'll read more descriptions of wetlands written with different objectives in mind. You'll have a chance to decide how accurate each description is. Finally, you'll be able to create your own piece of literature--scientific report, news account, short story, poem, or play--in which a wetlands is described.

THE ACTIVITY

1. Activity Packet #9 contains four selections that describe wetlands. One is taken from a famous short story by Sir Arthur Conan Doyle. A second is a news report from a major Canadian news magazine. The third is a scientific report on a wetland area. The fourth is a poem by Carol Wilson-Jenny. Take these out and read them carefully.

2. As you finish each selection, summarize its description of the wetland involved. In short sentences, list the information given about the bog, swamp, or marsh. Then, for each item on your list, tell whether you think the information is correct or not. If it's wrong, tell what's wrong with it. Don't try to judge the scientific accuracy of the Niering and Warren selection. Do try to decide how other scientists might judge his paper. Would they accept what he has to say simply because he is a scientist? If you did have any question about this author's reliability, how would you check it out?

3. Finally, choose a wetland you know to write about. It should be one that you have seen or one that you could visit easily. If you have done any research there (for other activities), you might write a brief scientific report. If there is public interest in the wetland, you could do a news article. Or you might try to describe the wetland in a poem, song, or as part of a short story or play.

SUMMARY QUESTIONS

1. What characteristics of a wetland are likely to be mentioned in a scientific report? In a news article? In a short story or poem?

2. What factual errors are contained in the selection in the "Background" section above?

3. Would it ever be permissible to use incorrect information about wetlands in a piece of literature? Why or why not?

GOING FURTHER

Find at least two other forms of expression about wetlands. This could be an advertisement, campaign literature, artwork, government regulations, or the like. Then analyze this material as you did in section 2 above.

10

The Extinction of Species in the Wetlands

OBJECTIVE

In this activity you will have an opportunity to investigate those species of wetland organisms in danger of becoming extinct. You can find out where these endangered species live. You might also investigate, in detail, the causes of the precarious situations of selected species.

BACKGROUND

Between 1600 and 1850 five species of vertebrates became extinct in North America. Between 1850 and 1980 at least 60 species of North American vertebrates have become extinct. The list includes 18 mammals, 30 birds, and 12 fish. Today hundreds of species live in danger of becoming extinct. They are classified as endangered.

Endangered species must have direct help from humans to survive. While some species may have been eaten, skinned, or shot to extinction, more organisms are affected by the indirect activities of humans. Most commonly we change the environment in which the organism has been adapted. The change may be physical as in the draining of a marsh, the damming of a river, or the polluting of a habitat. The environmental change may also be biological as in the introduction of rats and plants, or the cutting down of a forest.

Ecologists view the rapid loss of species as a serious problem. Ecosystems are made up of many species held together in food webs. As species are lost from a a web, the ecosystem becomes less complex. Complex ecosystems are stable. Simple ecosystems are unstable. The survival of life forms in a simple ecosystem is more difficult.

In an African marsh ecosystem, hippos and snails feed on the same plant. The snails have a parasite which causes a human disease. After the hippos were killed off by hunters, the ecosystem became simpler--only snails now feed on the marsh grass. The population of snails increased and so did the human disease caused by the snail parasite. Animals and plants of the wetlands have been severely endangered by the changes humans make in marshes and swamps.

ACTIVITY

Activity Packet #10 includes a list of endangered species of the world. The list is published by the Endangered Species Bureau of the United States Fish and Wildlife Service. The packet also includes a map of the world.

1. Make a check next to the names of those organisms that you know are found in wetland habitats.

2. Select one or more groups of organisms (birds, mollusks, plants). Place a pin in the map of the world in the range of each endangered wetlands species.

3. Select one endangered species about which you can find information in your library. The whooping crane should work out well, but a species from your region will be best. Find out what happened to the organism, or its environment, that has led to its classification as "endangered." What has been done, is being done, or can be done to save this species? Should it be saved? Why?

SUMMARY QUESTIONS

1. What approximate percentage of the endangered species of the world are from wetland habitats?

2. What is characteristic of the parts of the world and the parts of countries that include the habitats of endangered species?

3. Report what you have found out about the causes of the endangered condition of the species you selected to investigate.

GOING FURTHER

1. Explain how farming has contributed to the superabundance of rats, deer, house sparrows, robins, and weeds, while at the same time driving species of mature and complex ecosystems toward extinction.

2. Polluting agents such as pesticides, heavy metals, chemical fertilizers, and ionizing radiation have their most deadly effects on certain types of species. They are species that occur in complex and mature ecosystems and occupy specialized positions in food webs. Explain why.

3. How did Rachel Carson, the author of SILENT SPRING, influence the enactment of the Endangered Species Act of 1966?

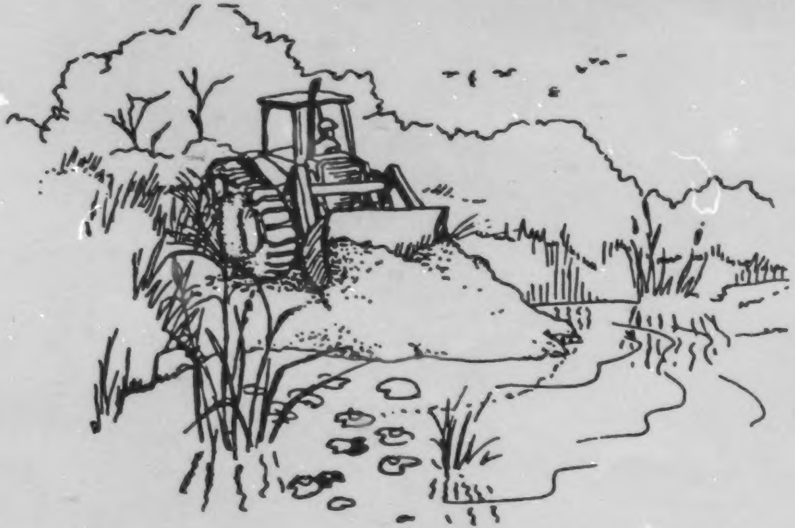
4. The wood duck and sandhill crane are wetlands animals that are not considered in danger of extinction. Yet these and other species are in danger of (regional) "extirpation." How do ecologists distinguish between extinction and extirpation?

11

The 404

OBJECTIVE

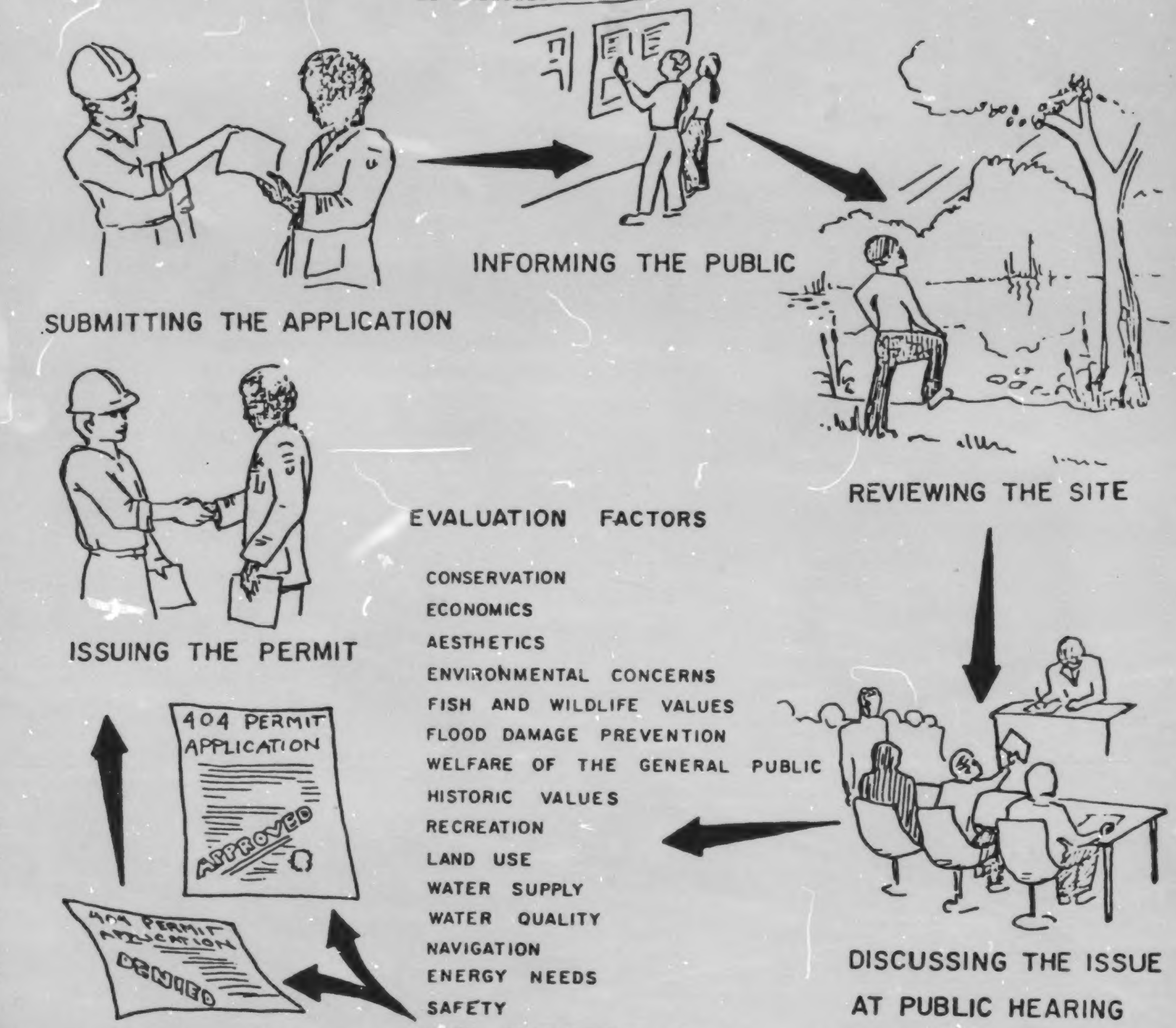
There are laws that protect wetlands, just as there are laws that protect your person and property. In this activity you will study how Section 404 of the Clean Water Act of 1977 protects our nation's wetlands. You will review the applications of companies which want to fill in wetlands. You will make your own recommendation on the application. And you will compare your reactions with the reactions of experts.



BACKGROUND

Wetlands can be seriously damanged or destroyed when they are filled with materials from the land or with materials dredged from water. A construction project at a wetland may threaten one or more species of animals. The filling of the wetland may deprive the community of a place valued for its beauty, history, or recreational value. The community water supply may be badly affected by pollution. Flood control could be affected. Or the proposed use of the wetland as a dry land site might be considered undesirable from an engineering point of view.

Section 404 of the Clean Water Act of 1977 requires most of those who plan to fill a wetland, in the course of a construction project, to obtain a permit. The 404 Permit Program is run by the Army Corps of Engineers, or in some states by a special 404 director. An applicant completes a permit form and submits it to the Corps or to the director of the state 404 program. A public notice is then issued. All concerned individuals, groups, and government agencies are invited to study and comment upon the plan to fill the wetland. Denial, approval, or changes in the construction plan may be recommended. Typically, the 404 permit review proceeds as follows:


SUBMITTING THE APPLICATION
INFORMING THE PUBLIC
REVIEWING THE SITE
DISCUSSING THE ISSUE AT PUBLIC HEARING
404 PERMIT APPLICATION
APPROVED
404 PERMIT APPLICATION
DENIED
ISSUING THE PERMIT

EVALUATION FACTORS

- CONSERVATION
- ECONOMICS
- AESTHETICS
- ENVIRONMENTAL CONCERNS
- FISH AND WILDLIFE VALUES
- FLOOD DAMAGE PREVENTION
- WELFARE OF THE GENERAL PUBLIC
- HISTORIC VALUES
- RECREATION
- LAND USE
- WATER SUPPLY
- WATER QUALITY
- NAVIGATION
- ENERGY NEEDS
- SAFETY
- FOOD PRODUCTION

ACTIVITY

In this activity you will review two applications for 404 permits, provided in Activity Packet #11. Begin by reading the public notice of a 404 permit application. Next decide, on the basis of information provided in the notice, whether you approve, deny, or recommend changes in the construction plan. Then read the file that followed the application. This file includes the findings and recommendations of experts who studied the applications and, in some instances, visited the site of proposed construction. Thus you will be predicting the outcome of both of the 404 permit applications. You will see how your recommendation corresponds with the recommendations of others.

First, read the 404 permit application. Second, think about and discuss pros and cons of the application. Third, write out your recommendations and reasons in the spaces below. Fourth, read the file to compare your recommendations with those of the experts.

SUMMARY QUESTIONS

What action do you recommend for each 404 permit application as described in public notices? Give at least one reason for your decision.

1. PUBLIC NOTICE 071-OYA-4-003538
   Winchester Bay Development Co.

   Your recommendation ______________________________

   Reason ______________________________

   ____

   ____

2. PUBLIC NOTICE 071-OYB-4-006264
   Puget Sound Power and Light Company

   Your recommendation ______________________________

   Reason ______________________________

   ____

   ____

GOING FURTHER

1. Contact your local office of the Army Corps of Engineers, your regional office of the Environmental Protection Agency, or your state director of the 404 Permit Program. Request copies of recent public notices of 404 permit requests. Study the notices. If possible visit the sites of proposed work. Interview persons who are concerned with the project. Make your own assessment of the situation. Then communicate your recommendation, if the permit is pending, to the Corps of Engineers.

2. Today the average 404 permit application is a document ranging from several centimeters to several decimeters thick. The applications are often written by lawyers in a legal language most citizens do not understand. Find out whether the involvement of lawyers is generally viewed as a desirable development.

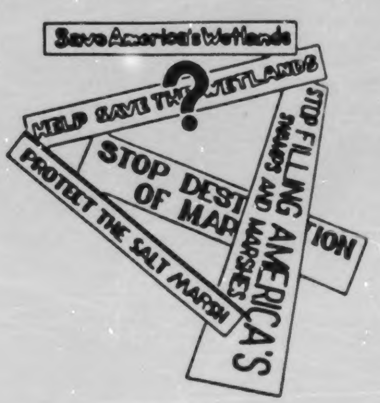
3. Set up a class debate on the issue of whether the government should have the right to establish such strict legislation. After all, if persons own private property in the wetlands, why can't they do with it what they want?

12

How Effective are Environmental Action Campaigns?

OBJECTIVE

How can you change human behavior? How are people influenced or persuaded into supporting a cause? How effective are environmentalists' campaigns to save a wetland or an endangered species? In this Activity you can make a case study of an environmental action campaign. Or you can join an environmental action group and find out about campaigns from the inside.



BACKGROUND

Social change nowadays seems to depend upon dramatic media campaigns. The election of a president requires heavy radio and television coverage, newspaper pictures and articles, mailings, billboards, posters, buttons, bumper stickers, and hats. Sometimes the media campaign is so dramatic that people lose sight of their cause. The glitter of their campaign may attract supporters who like to join colorful and noisy parties and parades. In the end, supporters of a media campaign may be lost because they never really understood or believed in the cause. On the other hand it is often hard to inform a public of the complicated facts of issues, and at the same time fire them up with enthusiastic support for a course of action. Influencing public opinion and action requires great skill.

Since the late 19th century environmental causes have been championed. Among some of the major successful campaigns were efforts to:

- achieve zero population growth;
- save redwood forests in California;
- preserve wilderness in a third of the State of Alaska;
- stop the slaughter of American Bisons;
- enact the Endangered Species Act of 1966.

Each of these achievements was the result of the organized efforts of concerned groups.

Equally important have been the efforts of environmentalists who have worked on causes in local communities. To save a marsh from being filled in, a swamp from logging, or a lake from a housing development almost always requires the efforts of local action groups.

In every instance the concerned group must fully inform itself of all facts of a case. The groups must decide on its goals, and then work out a strategy for achieving these goals. The final success of the campaign depends upon the action the group of organizers takes.

THE ACTIVITY

In this activity you have the option to follow one of two paths:

1. You may choose to carry out an historical case study. With this option you will identify a local environmental cause of the recent past (preferably on a wetlands issue). You will find out about the nature of the issue and facts by reviewing newspaper accounts and interviewing participants. Also, you will review the strategies of those who campaigned for and against particular actions. Finally, you'll evaluate how well the participants conducted their campaign and what they might have done differently. See the retrospective study guidelines in Activity Packet #12.

2. The second alternative is to identify in your community one hot environmental issue (preferably on wetlands). Find out all you can about all sides of the issue. Make up your mind about where you stand on the issue. And then throw yourself into the campaign. See the Prospective Study guidelines in Activity Packet #12.

SUMMARY

1. Briefly summarize the environmental issue you chose to study.

2. What were (are) the strategies used by the action groups to achieve the goals of their campaign?

3. What evidence is there that specific activities of the group yielded specific results?

GOING FURTHER

1. Request literature from activist groups that are trying to effect social change where environmental issues are involved. Write to such organizations as Green Peace, The Sierra Club, The National Audubon Society.

2. Study the history, and evaluate the strategies, of a national or international campaign to reduce human population growth, or save the whooping crane.

Glossary

Aerobic	With oxygen.
Anaerobic	Without oxygen.
Angiosperm	Any flowering plant.
Basin	A pond, reservoir, or other large bowl-like hollow containing water.
Bedrock	Solid rock beneath the soil and loose rock.
Biosphere	The combination of the zones of air, land, and water, at the earth's surface, occupied by living organisms.
Boulders	Sediment particles larger than 256 millimeters in size.
Bryophyte	Plants which do not have true leaves and roots and which do not have a fully developed system for transporting water and nutrients from one area of the plant to another; found in moist areas.
Catchment	A reservoir or basin which serves to hold water.
Climax forest	The final and most stable community in a series of communities in a succession.
Cobbles	Sediment particles between 64 and 256 millimeters in size.
Colonization	The establishment and growth in close association of a group of organisms of the same species.
Community	All the populations inhabiting a defined area and interacting with one another.
Decomposers	Organisms which consume organic compounds. The process releases inorganic nutrients which can be reused by plants and other organisms.
Diversity	The degree of species abundance in a community, taking into account the variety of species as well as the number of individuals in each species.
Dominants	The most characteristic species in a plant community which by size and numbers determine the type and abundance of other species in the community.
Ecosystem	All the organisms in a community plus the associated non-living factors with which they interact.

Emergents	Plants whose roots are under water, but part of the plant stands up out of the water.
Endangered species	Species whose habitats, food sources, and lives are in danger of destruction by human activity.
Estuary	A semi-enclosed body of water where fresh water from land meets and mixes with salt water from the sea.
Extinction	The death of a species.
First-level consumers	Organisms which gain energy by feeding on producer organisms; also called herbivors.
Frond	The leaf-like part or shoot of duckweed.
Germinate	To sprout; begin to grow.
Gravel	Sediment particles between 2 and 64 millimeters.
Herbaceous	Soft stemmed, non-woody plants.
Intermittent	Discontinuous; periodic; stopping from time to time.
Intertidal	The area, on the shore, which is between high tide mark and low tide mark.
Intolerant species	Organisms which cannot survive a certain pollutant or stress introduced into their community.
Isotherm	A line on a map connecting points having the same temperature.
Lichen	A fungi and an alga living in closs association. The fungi benefits from the relationship and the alga neither gains nor loses.
Mud	A soft, sticky, wet ooze comprised of a mixture of silts and clays.
Niche	A specie's role and associations in a community.
Non vascular plants	Plants which do not have transporting vessels. Water and nutrients are absorbed through root-like rhizomes as well as through the plant's surface.
Perennial	Having a life cycle of more than two years; returning and growing year after year.
Persistent	Emergent plants which usually remain standing until the beginning of the next growing season. They do not wilt away or break off.
Photosynthesis	The process in which plants use the sun's energy to convert CO_2 and water into food energy (carbohydrates).
Phytoplankton	Microscopic plants, capable of photosynthesis, found floating in oceans and lakes.
Pioneering	The first organism to colonize an era.
Pith	The spongy tissue in the center of certain plant stems.
Population	An interbreeding group of individuals of one species that occupy a given area at the same time.
Producers	Organisms which make their own food and which directly or indirectly provide food for all other organisms in a community.

Productivity	The rate of production of plants measured as calories per unit area per unit time.
Rhizomes	In vascular plants, an underground stem which usually runs horizontally and sends out roots from its lower surfaces and leaf-like shoots from its upper surfaces.
Salinity	Measurement of dissolved salts which are in a body of water.
Sand	Sediment particles between .062 and 2 millimeters in size.
Second-level consumers	Organisms which gain energy by feeding on first-level consumers; also called carnivores.
Sedentary invertebrates	Organisms without backbones which do not migrate; they are fixed in one spot.
Splash zone	The area along the shoreline which is above the high-tide mark but subject to moistening by saltwater spray.
Sporadic	Scattered; not constant or regular.
Submergents	Plants whose roots and leaves are under water.
Substrate	Solid material on which an organism lives, or is attached.
Subtidal	Not being exposed at low tide; area in coastal waters below the low tide mark.
Symbiosis	When two dissimilar organisms live together in a close association which is advantageous to both.
Tracheophyte	Plants with a complex system for transporting water and nutrients from roots to leaves (vascular plants).
Vascular plants	Plants containing vessels which transport water, salts, and food materials from the roots to the leaves.
Zooplankton	Microscopic animals found floating and swimming at the surface in oceans and lakes.

Bibliography

Freshwater Wetlands: Their Nature and Importance to Man. Norton H. Nickerson. Tufts University, 1978.

Who Killed the Bog Men of Denmark and Why? Maurice Shadbolt. Reader's Digest, July 1977.

Classification of Wetlands and Deep-Water Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, 1977.

Life and Death of the Salt Marsh. John and Mildred Teal. Ballantine Books, Inc., 1969.

The Ecology of Wetlands in Urban Areas. William A. Niering, Preserving Our Freshwater Wetlands. Connecticut Arboretum, Connecticut College, Bulletin number 17, 1970.

The Life of the Marsh: The North American Wetlands. McGraw-Hill Book Company, New York, 1966.

Life in and Around the Salt Marshes. M.J. Ursin. Thomas Crowell Company, New York, 1972.

Seasons of the Salt Marsh. David Alan Gates. The Chatham Press, 1975.

The Okefenokee Swamp. Franklin Russell and editors from Time-Life Books. Time-Life Books, New York, 1973.

Tide Marsh Guide. Mervin Roberts. E.P. Dutton, New York, 1979.

The Life of the Seashore. William H. Amos. McGraw-Hill Book Company, New York, 1966.

The Life of the Pond. William H. Amos. McGraw-Hill Book Company, New York, 1966.

What is Ecology? D.F. Owen. Oxford University Press, 1974.

Everybody's Ecology. Clay Schoenfeld. A.S. Barnes and Company, Inc., New Jersey, 1971.

Our Nation's Wetlands: An Interagency Task Force Report. Elinor Lander Horwitz, 1978.

Freshwater Wetlands: A Citizen's Primer. Thomas H. Miner. The Catskill Center for Conservation and Development, Inc., Hobart, New York, 1978.

What's the Use of a Salt Marsh? Charlene Van Raalte. The American Biology Teacher, May 1977.

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Chapter 4 - Puzzling Out a Food Web
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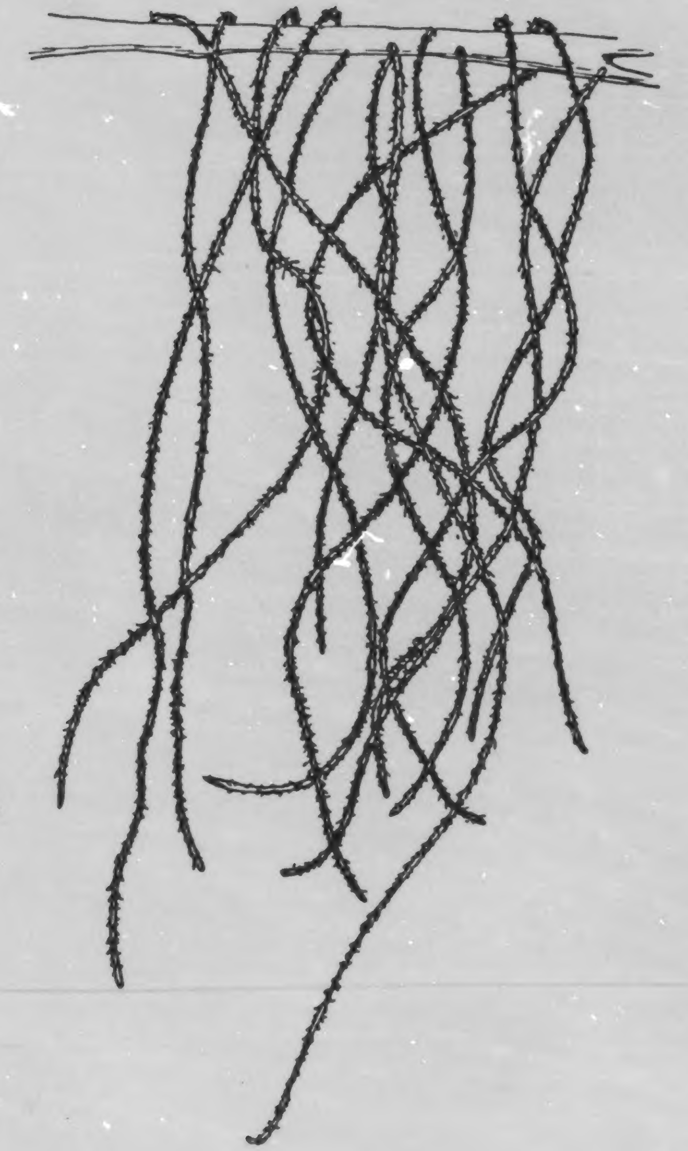
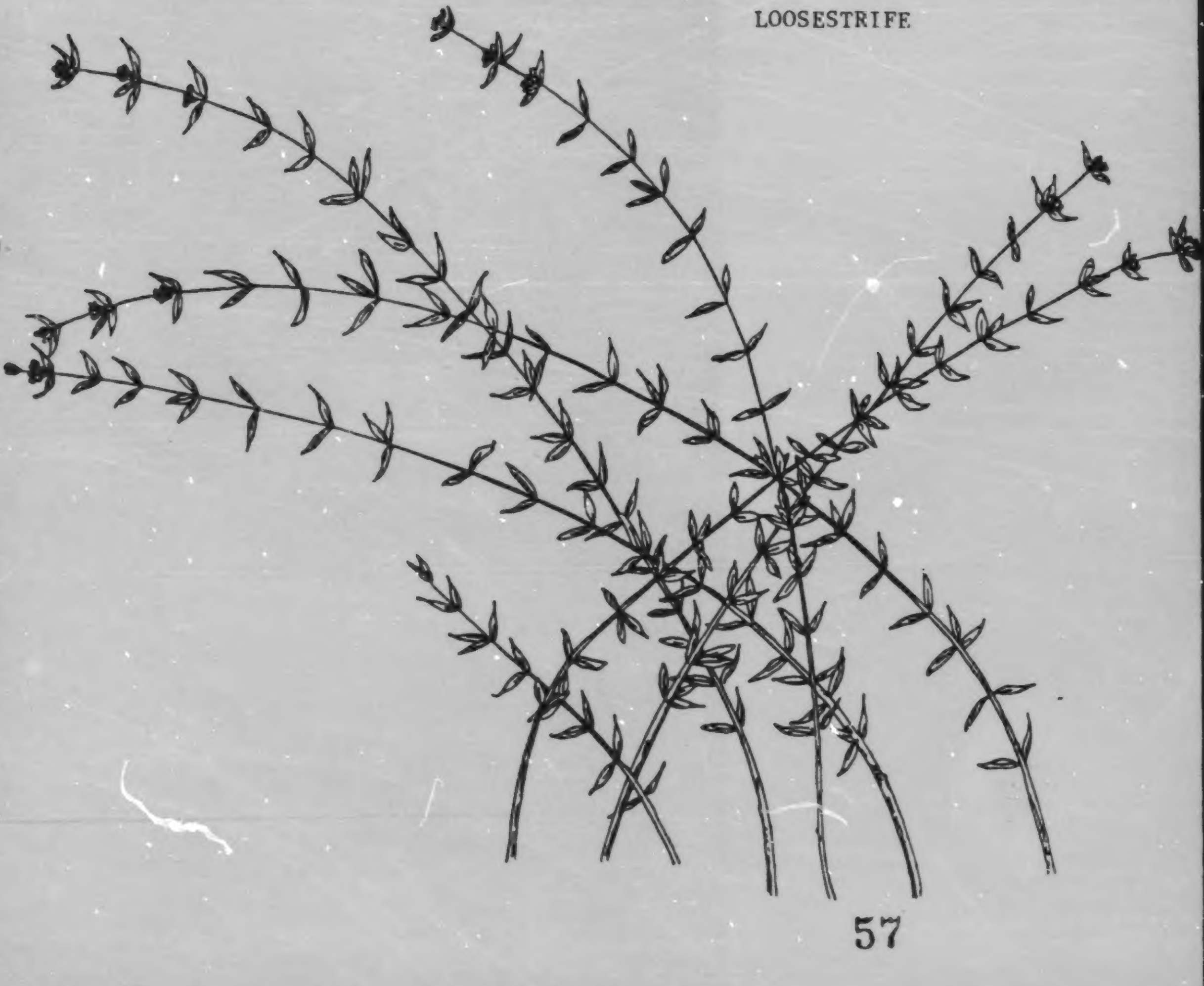
Swamps, Marshes, and Bogs

Chapter 2
Activity Sheets



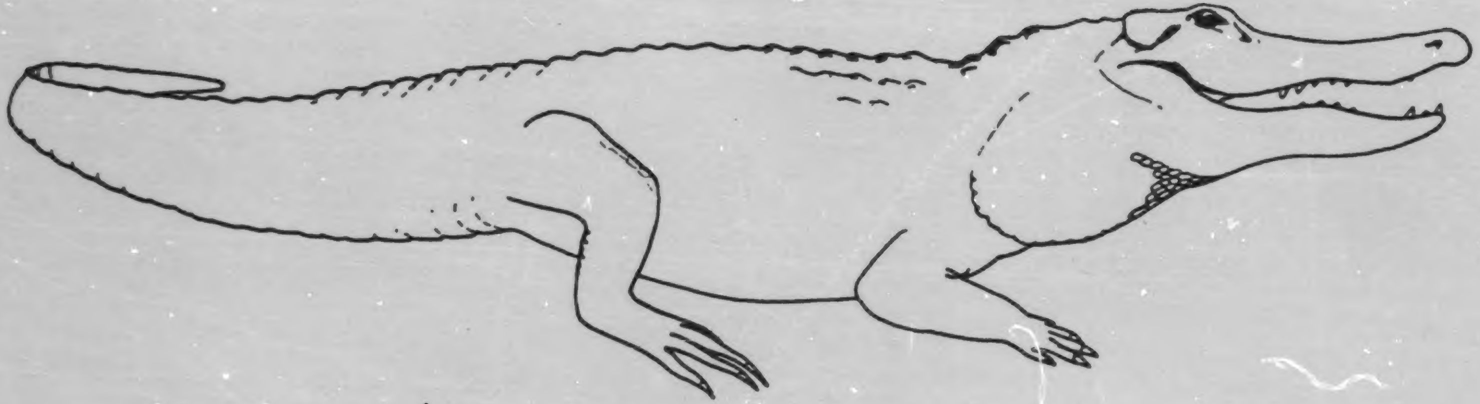
SPANISH MOSS

2-2



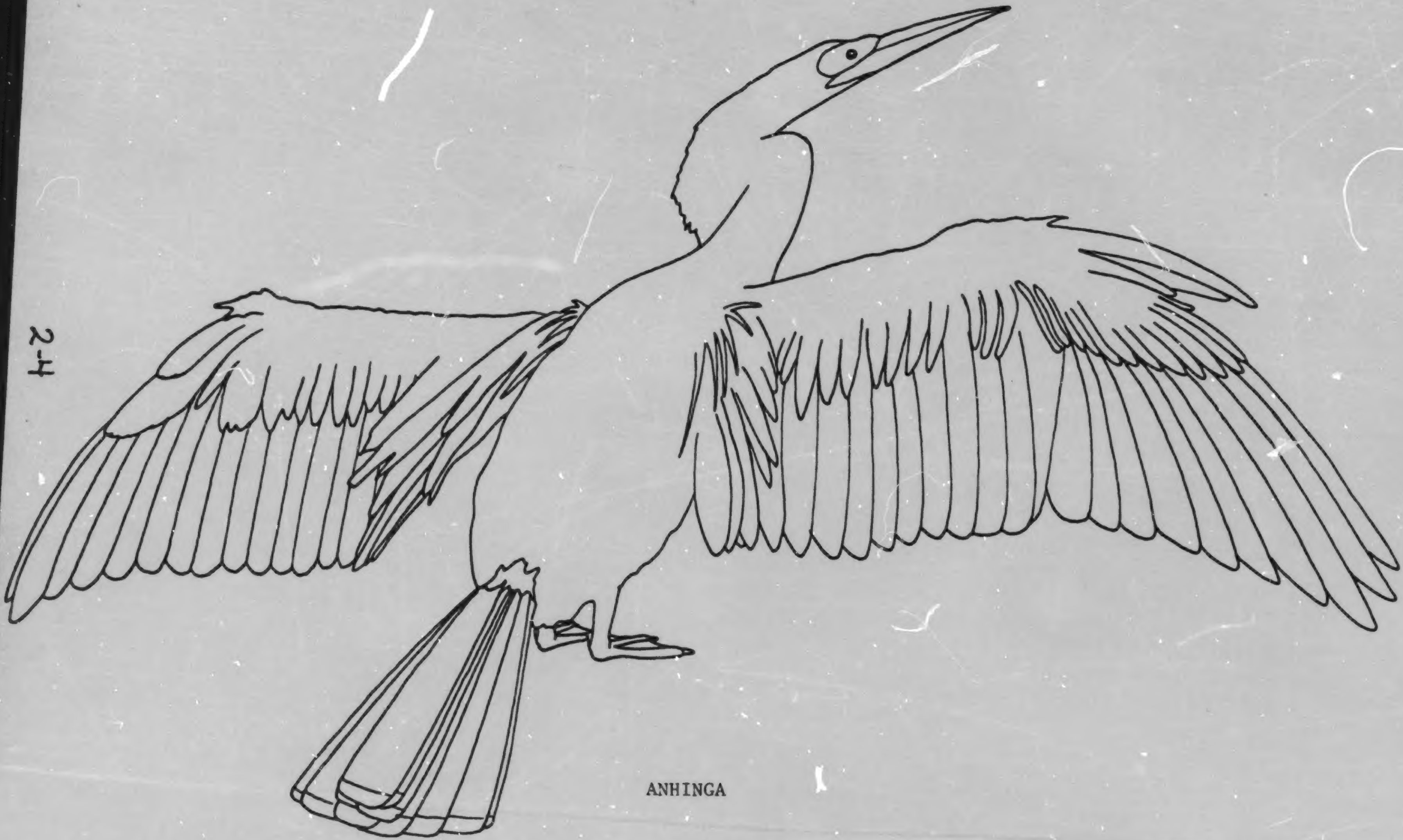
LOOSESTRIFE

2-3



ALLIGATOR

2-4



ANHINGA

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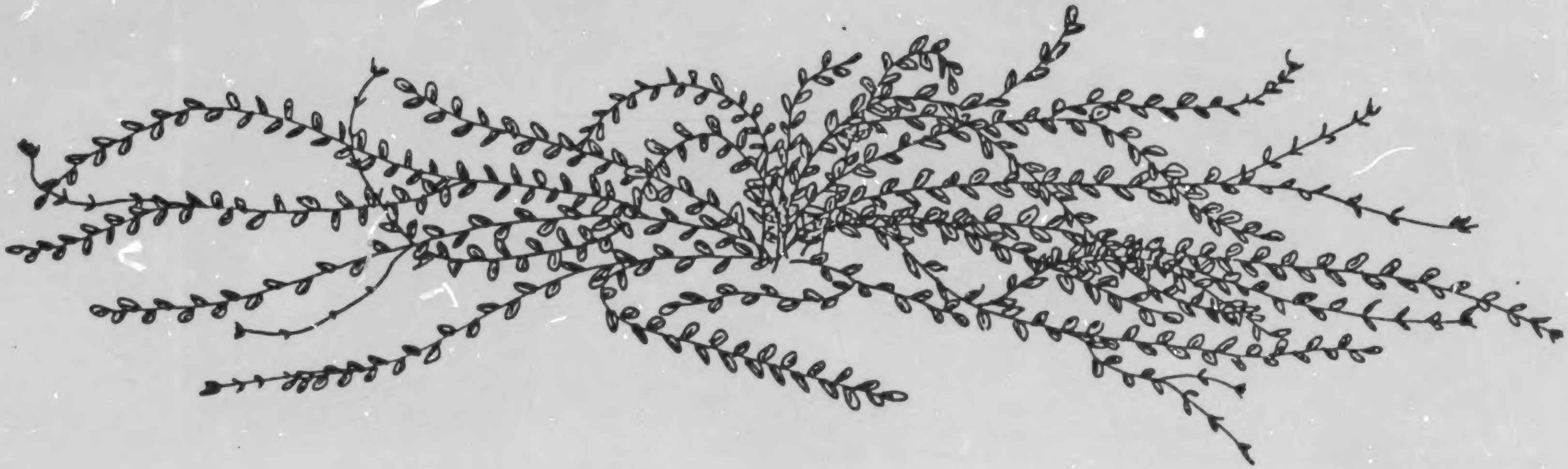

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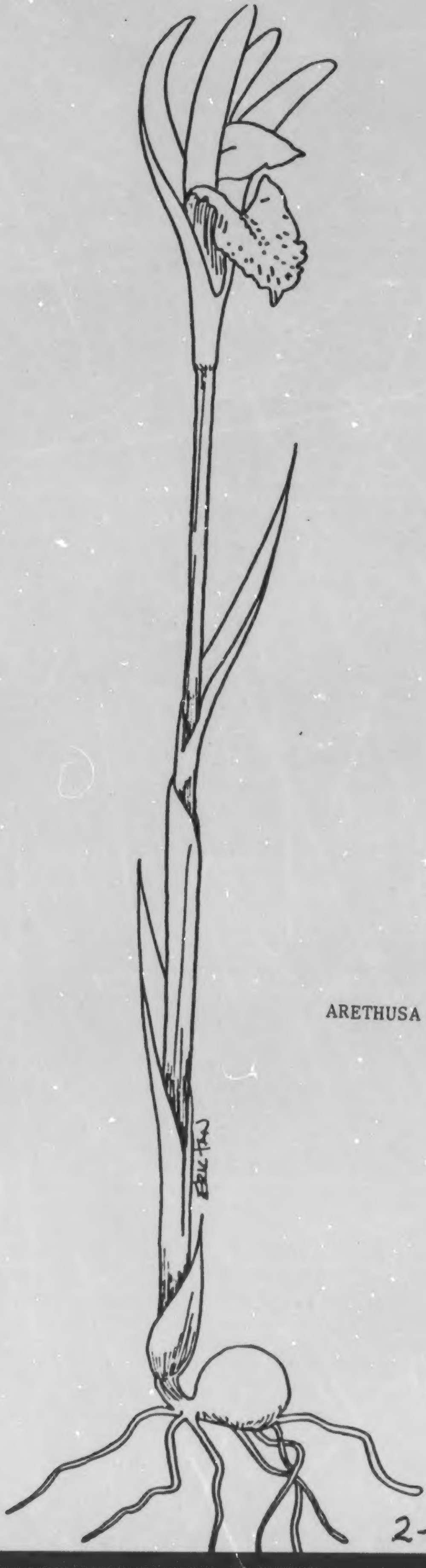
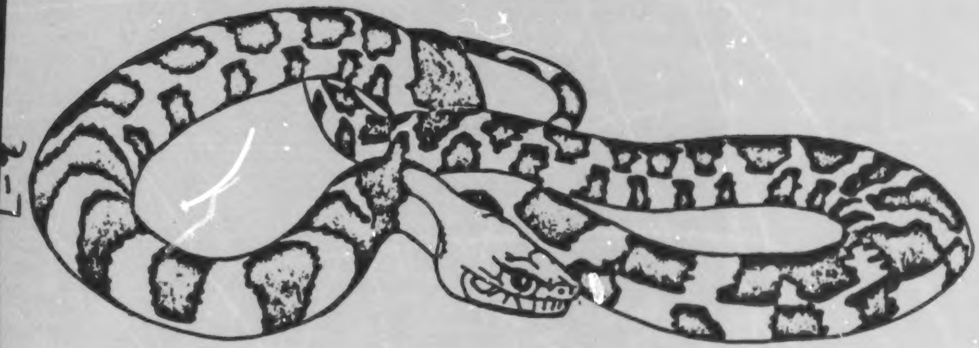
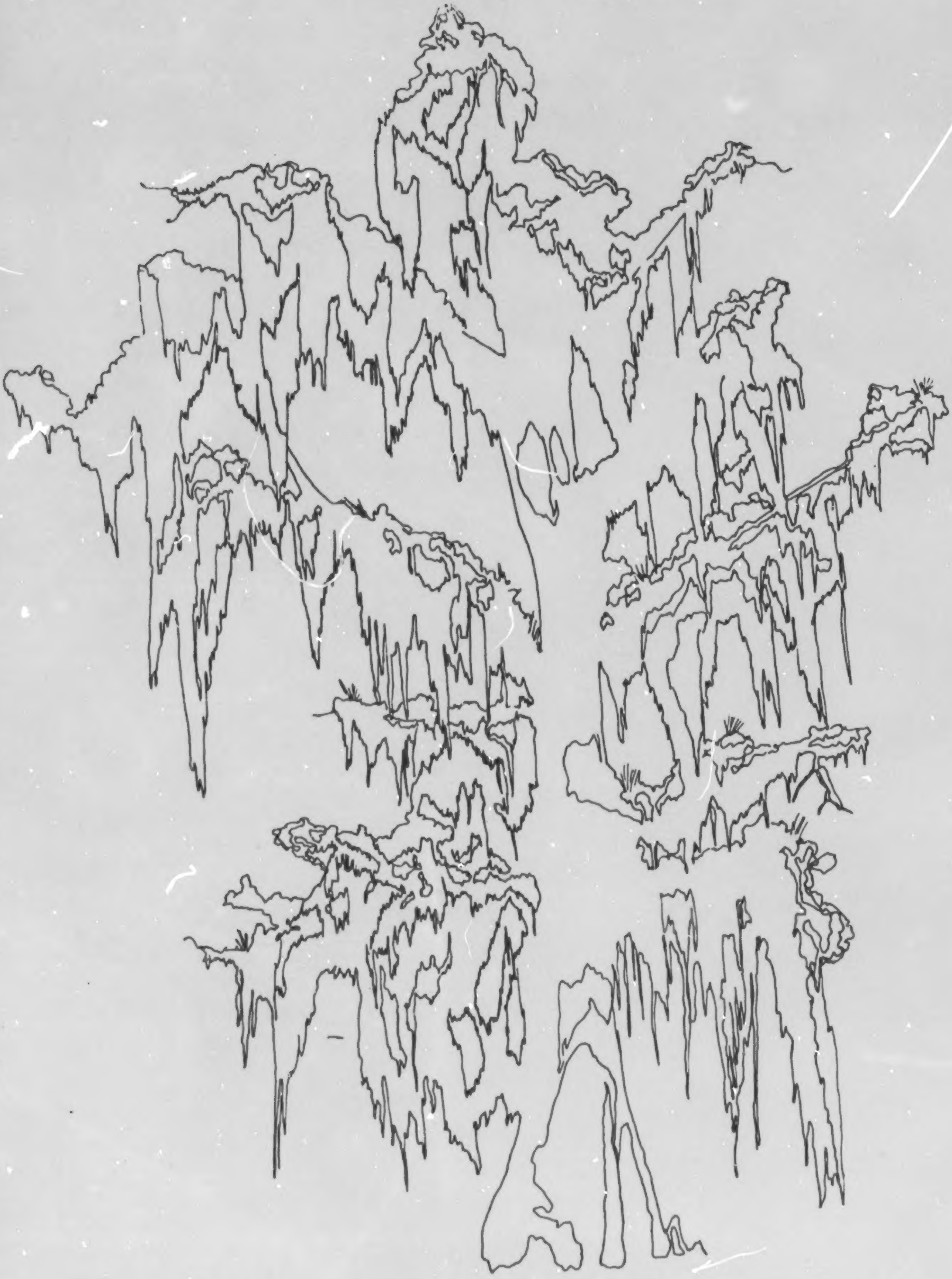


ARETHUSA ORCHID

2-6

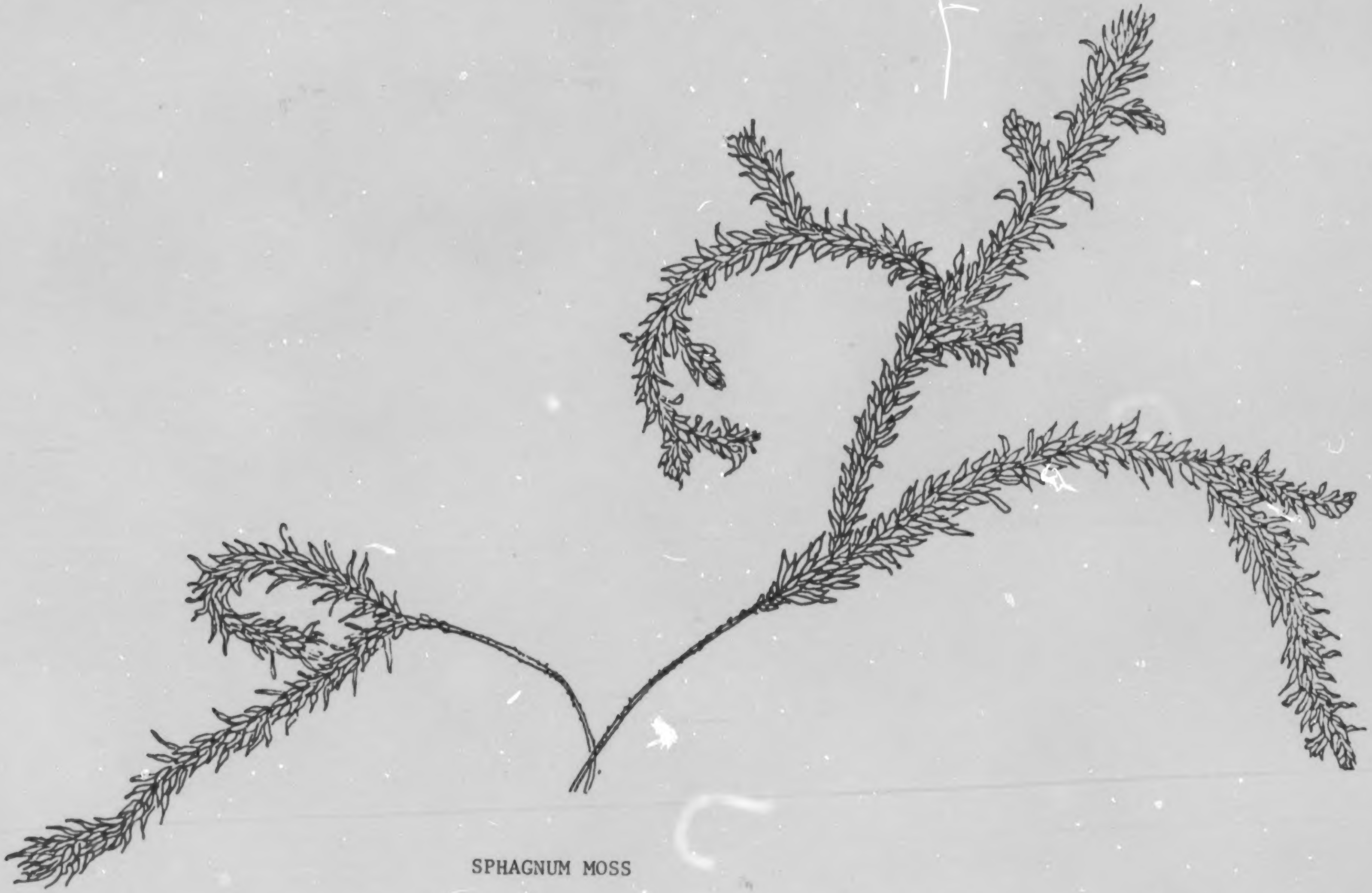


COTTONMOUTH



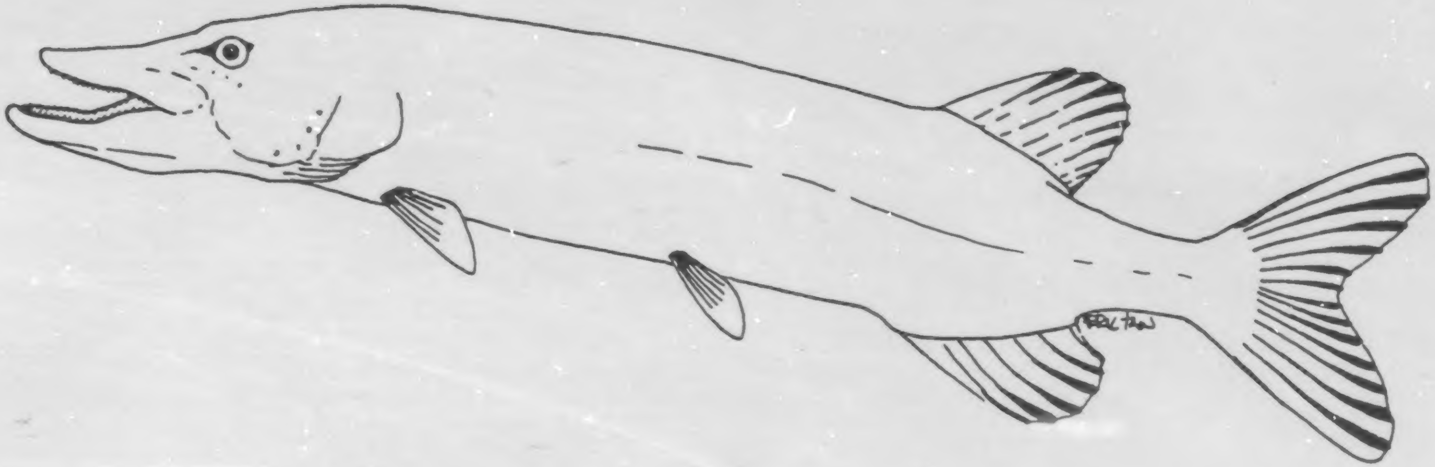
BALD CYPRESS 2-8 66

2-9.



SPHAGNUM MOSS

2-10



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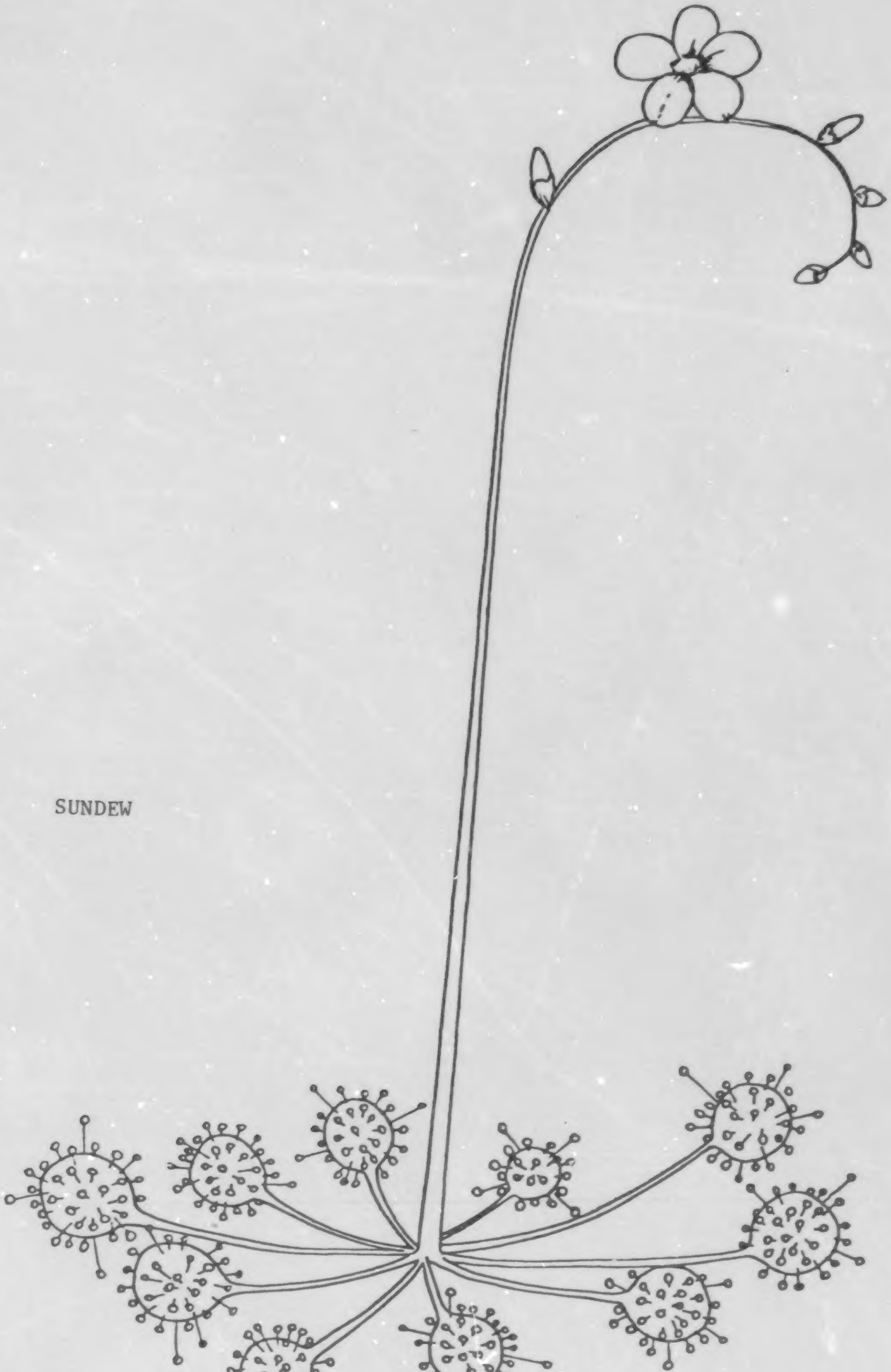
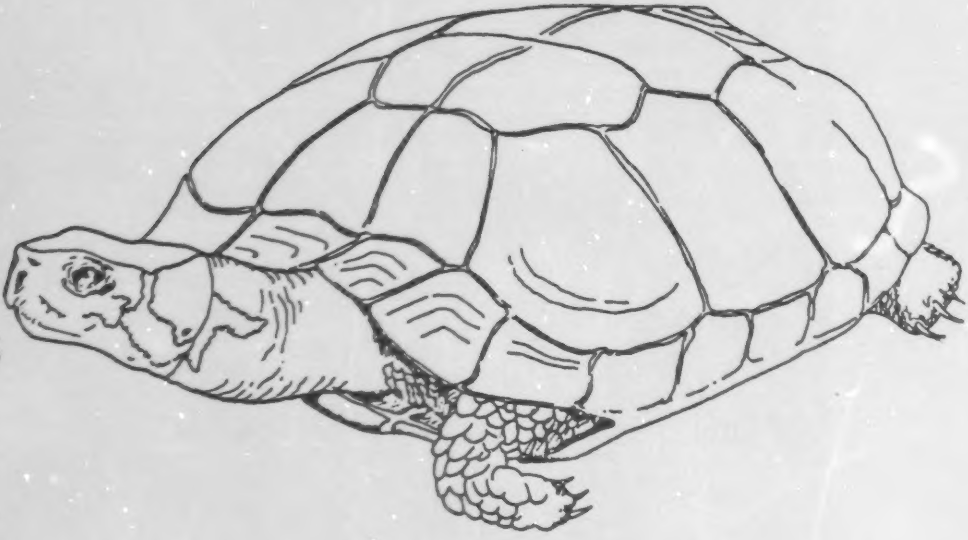


SUNDEW



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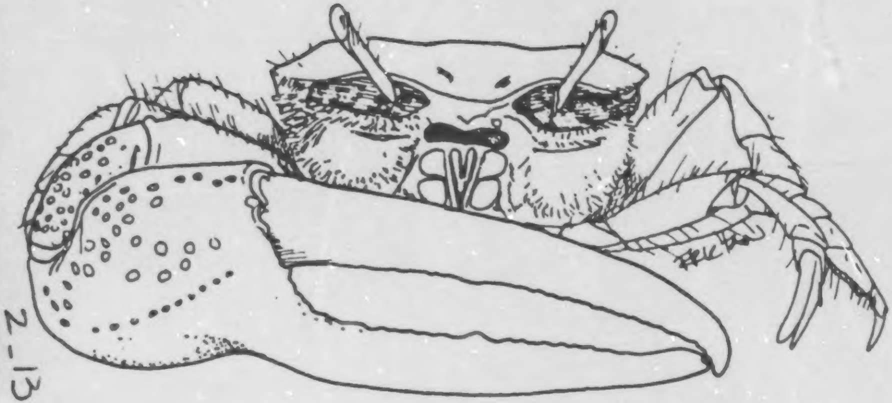
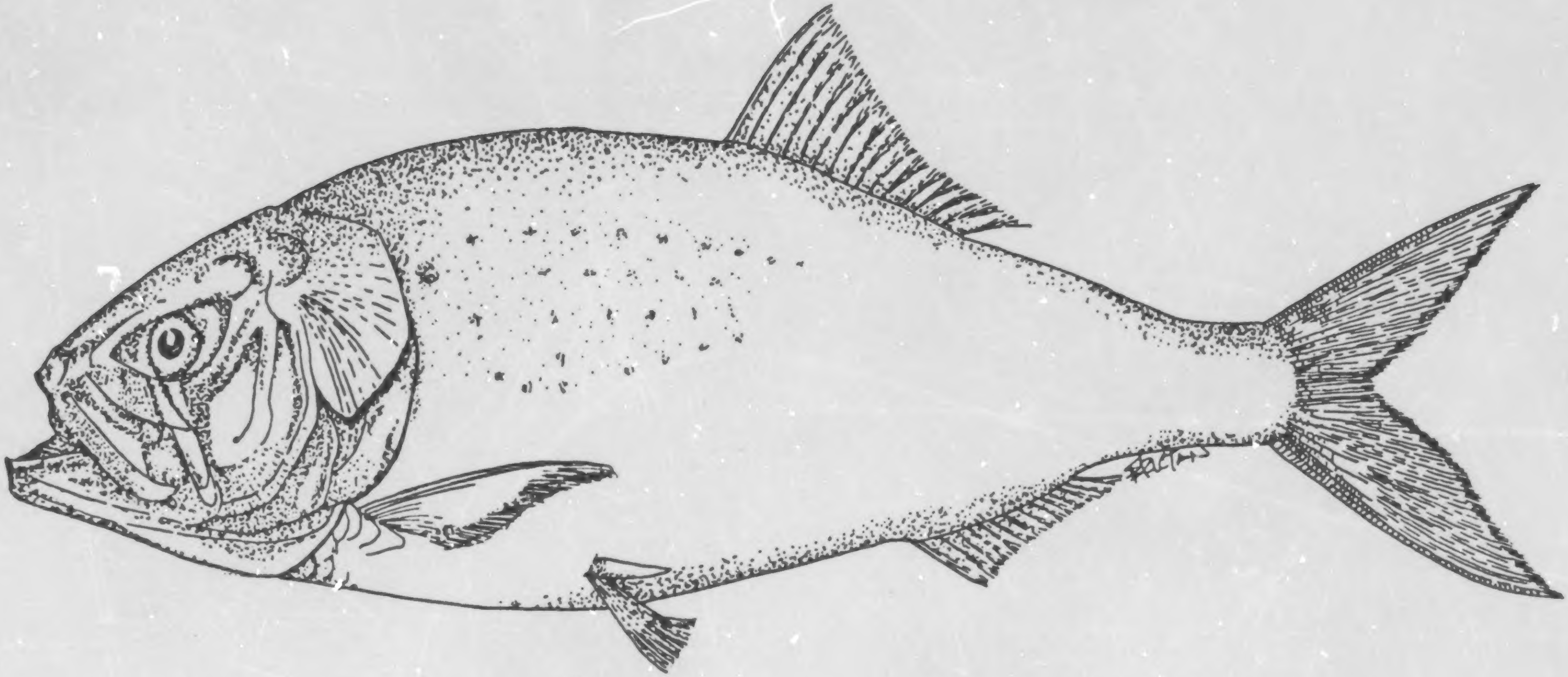
MUHLENBERG'S TURTLE



2-13

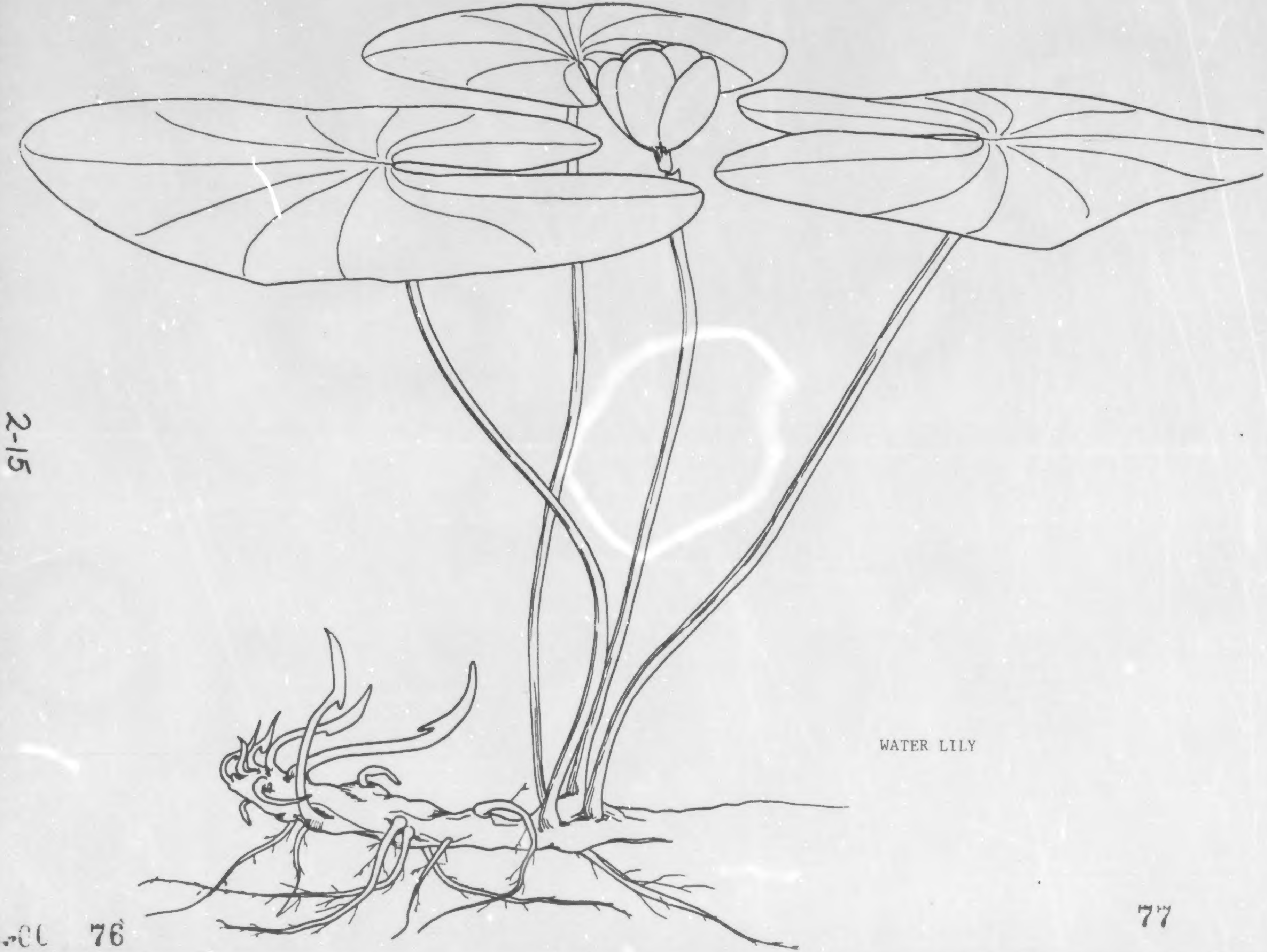
FIDDLER CRAB

2-14

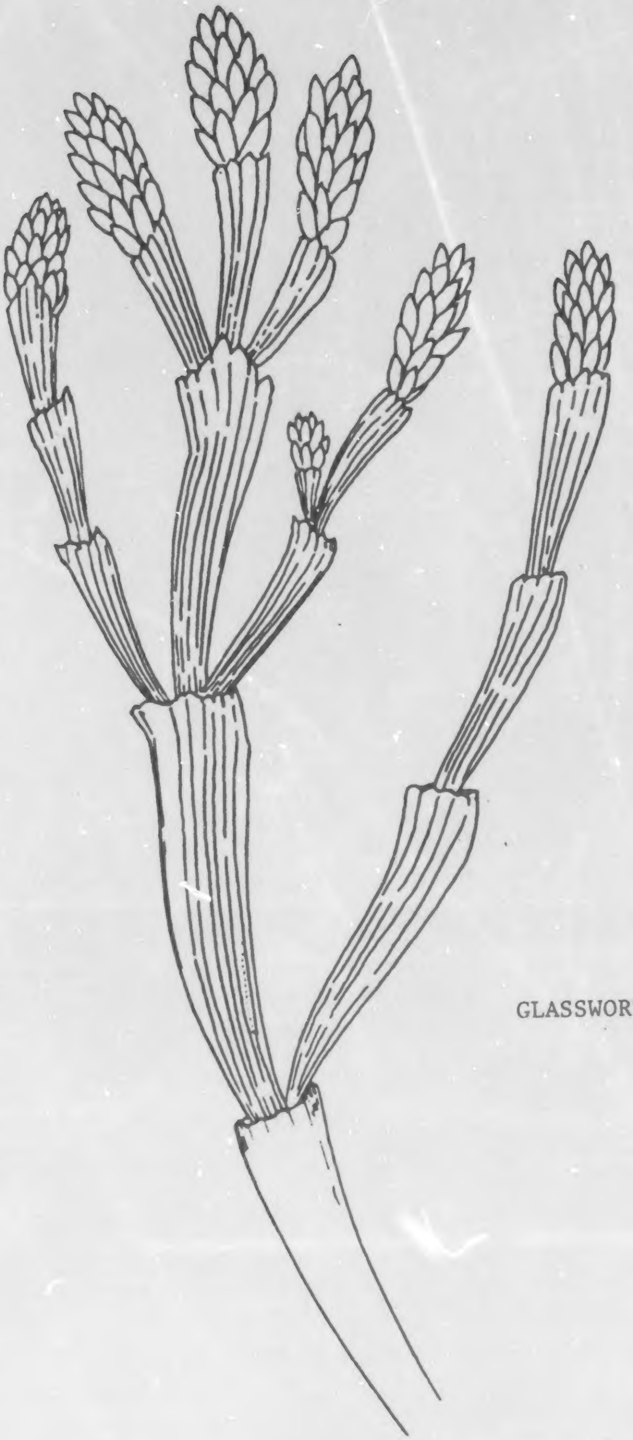


MENHADEN

2-15



WATER LILY



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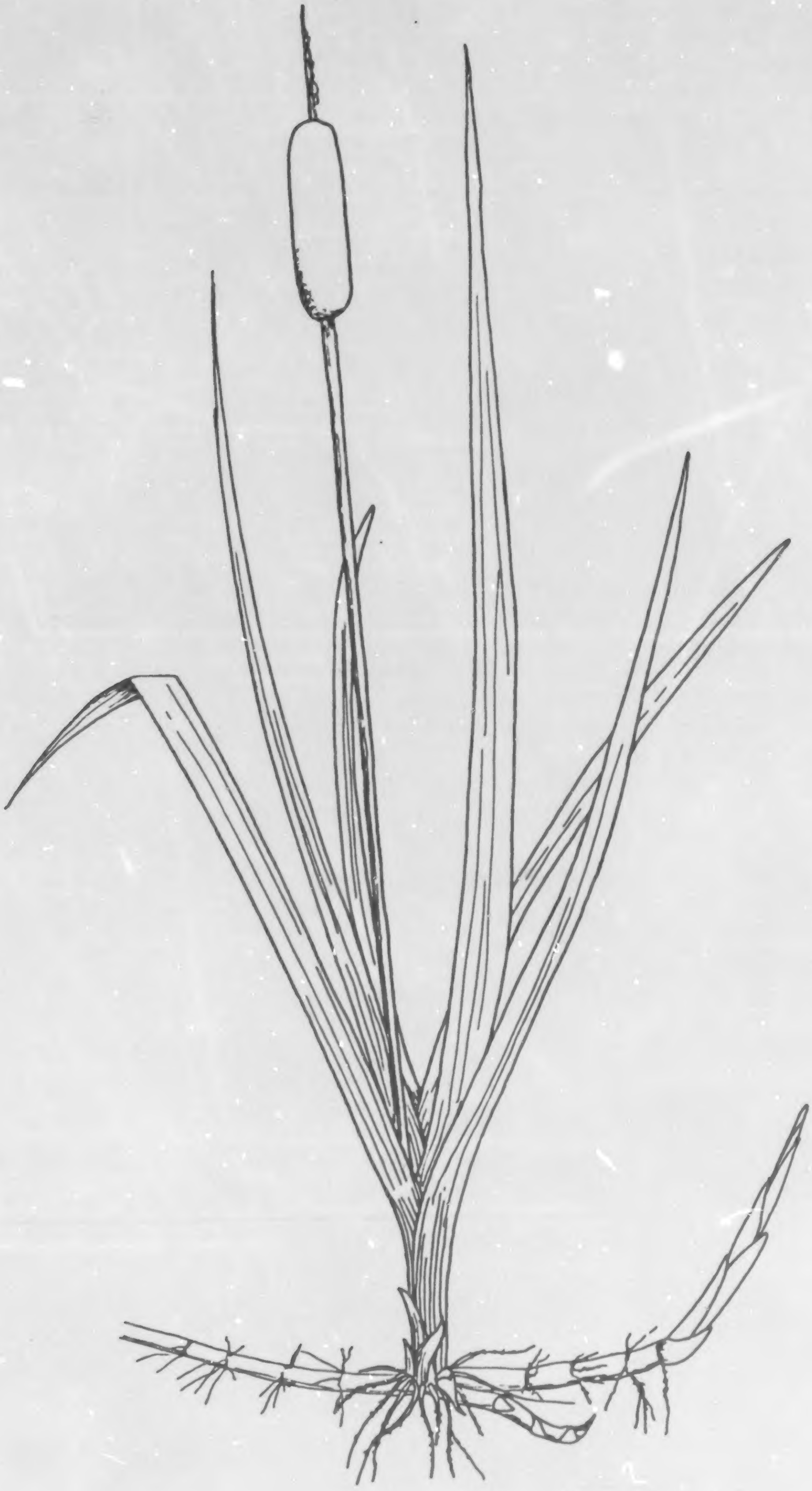
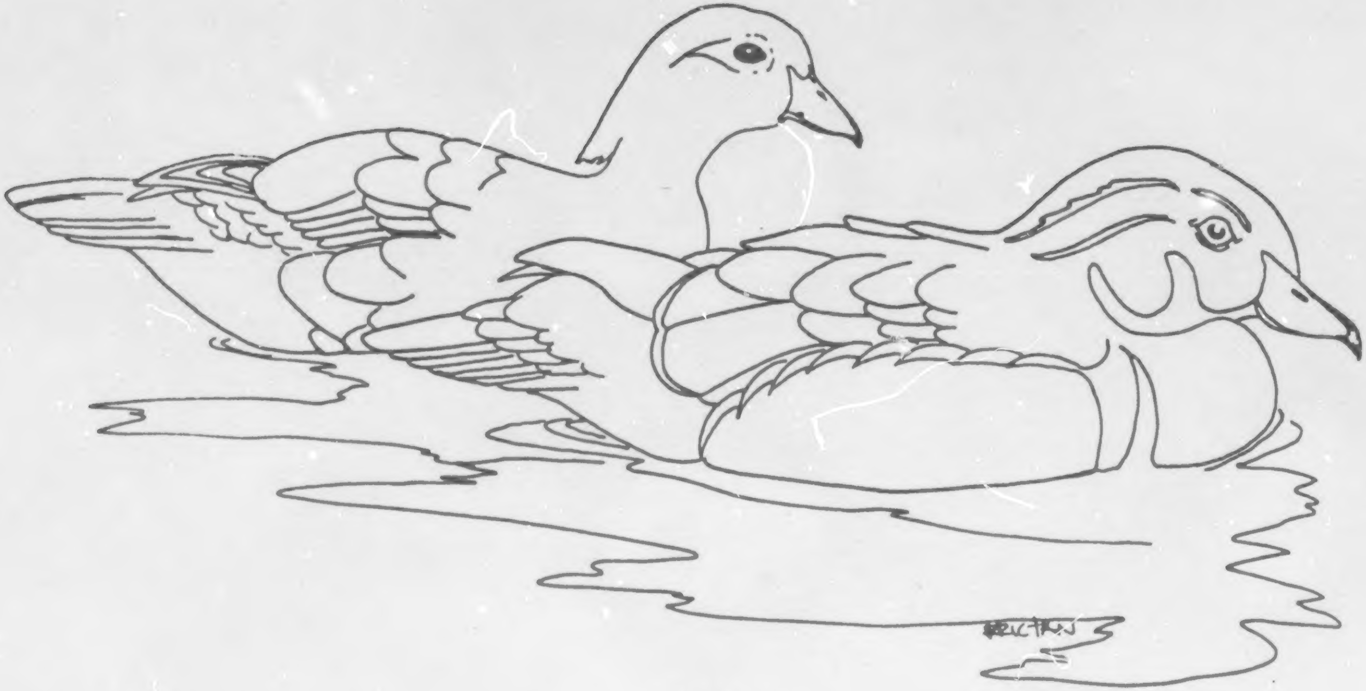


CATTAIL

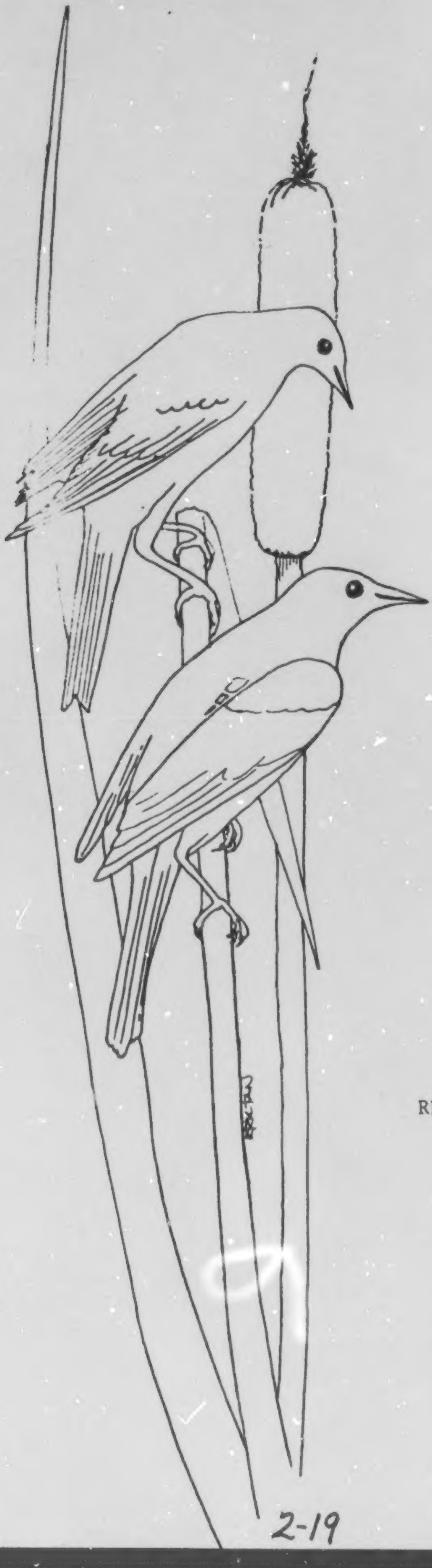
79

2-17

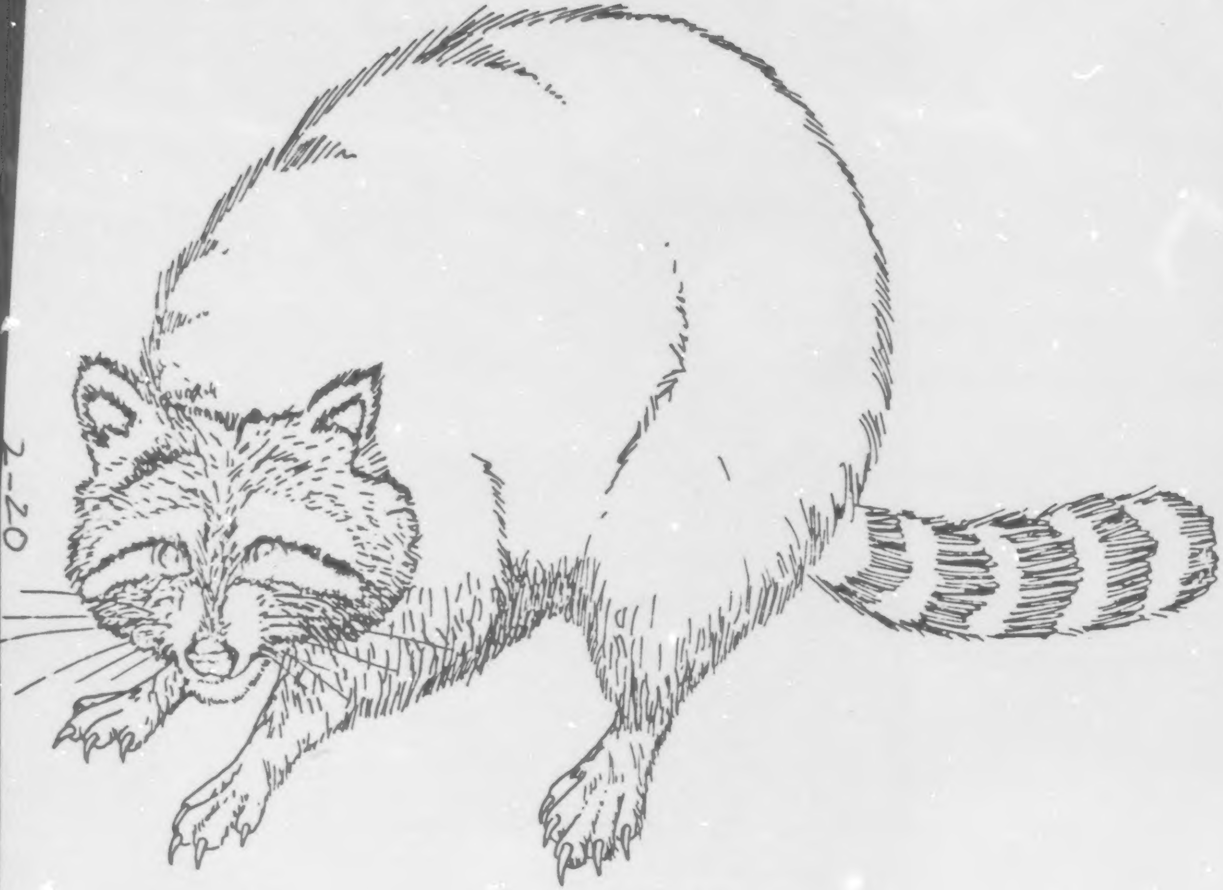
2-18



WOOD DUCKS

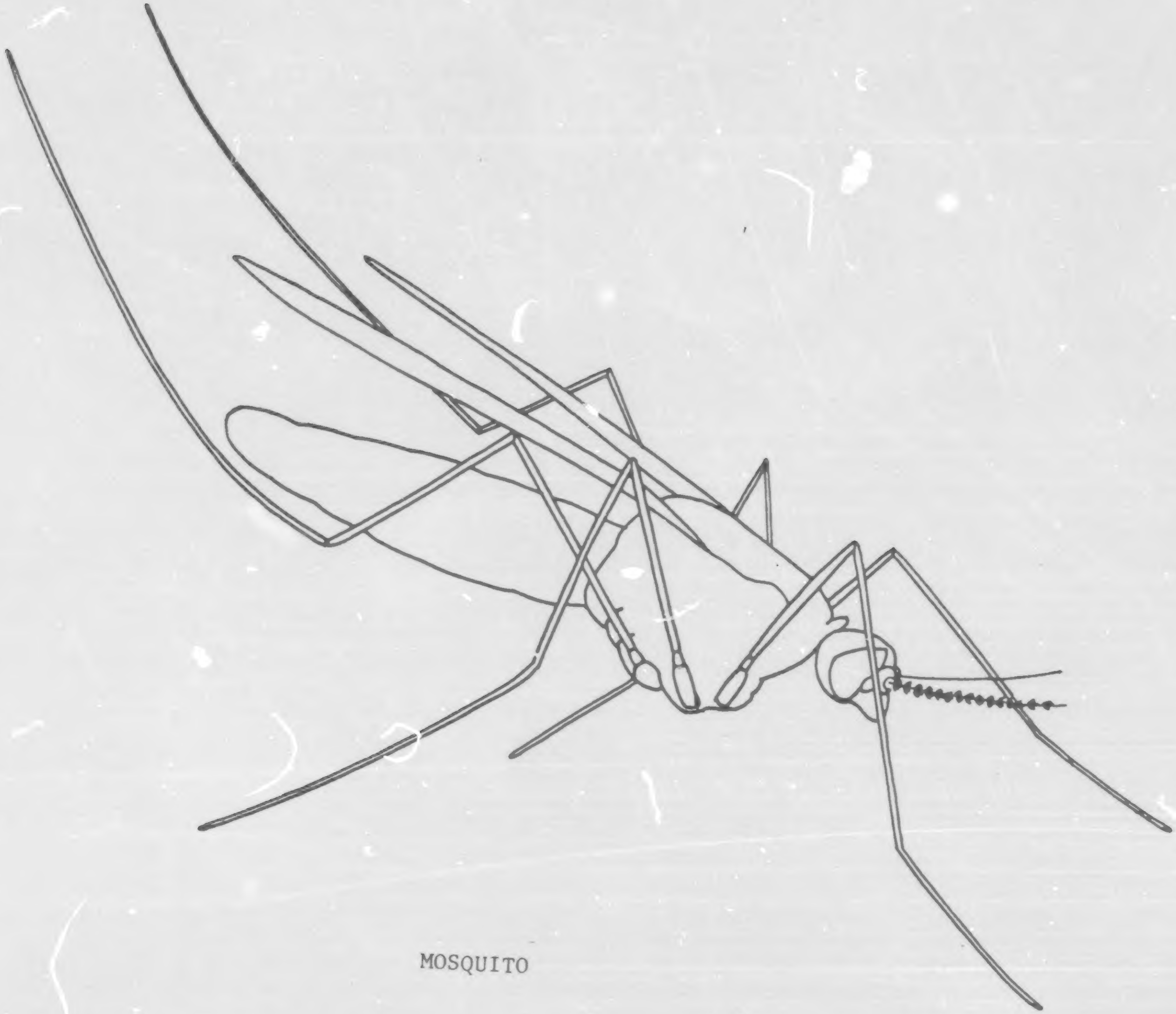


RED-WINGED BLACKBIRDS



RACCOON

2-20



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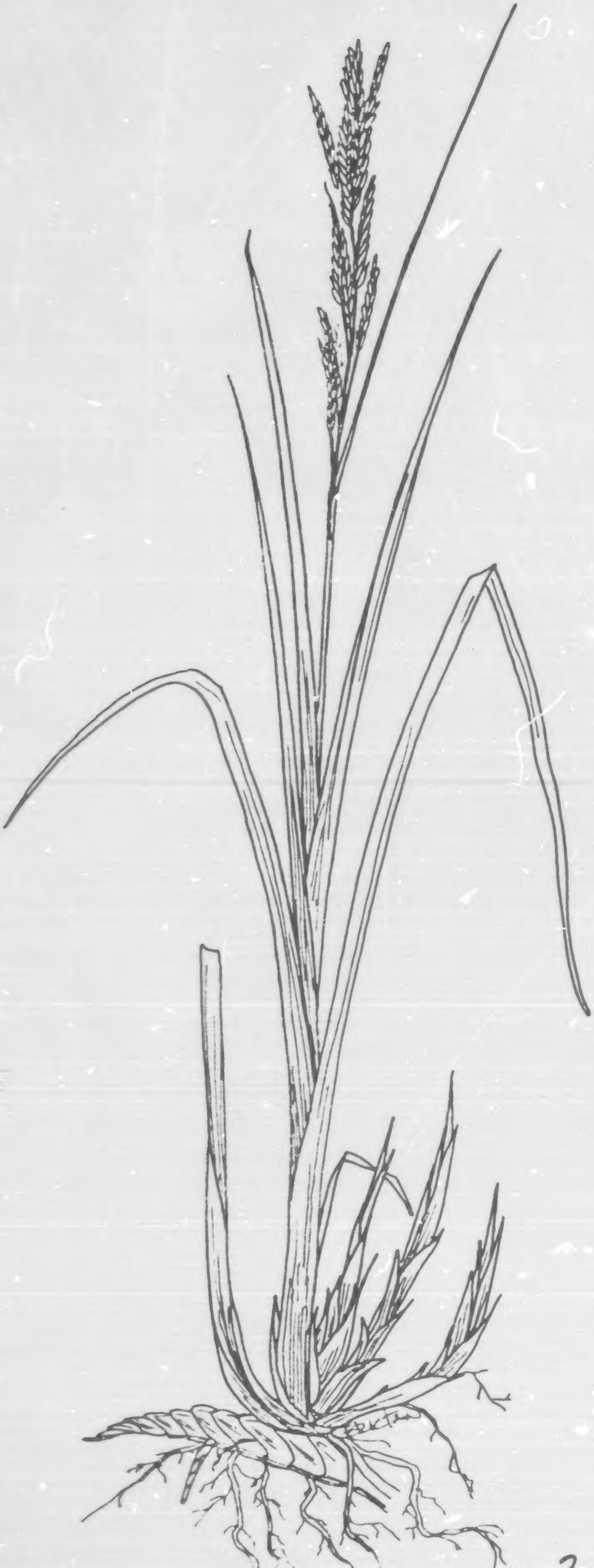
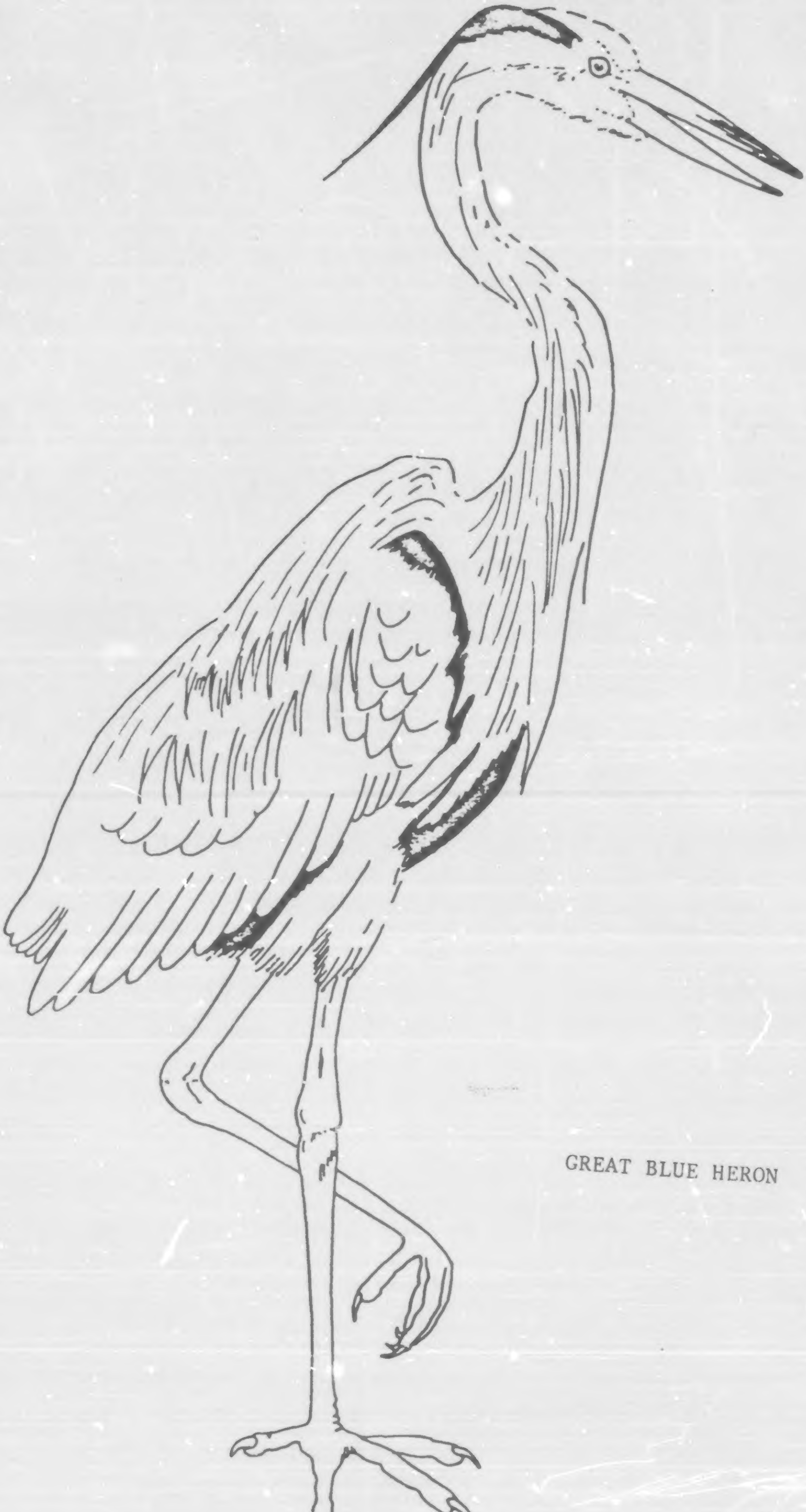


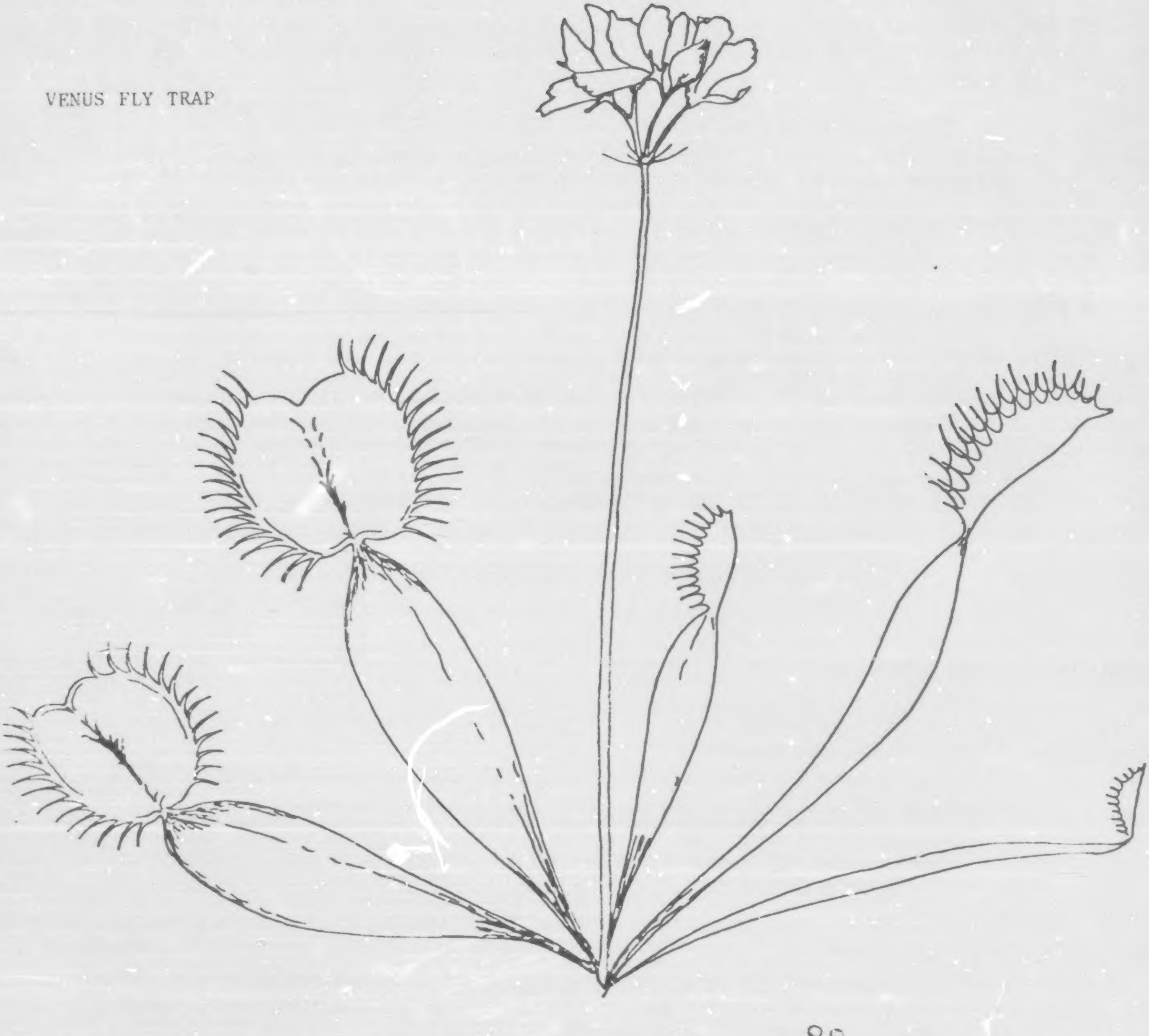
CORD GRASS



GREAT BLUE HERON

2-23

VENUS FLY TRAP



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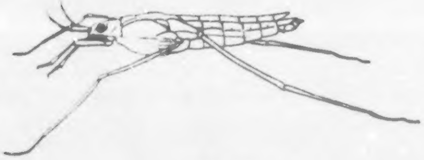
2-24

The Field Trip

Chapter 3
Activity Sheets

Activity Packet 3
Field Trip Task Card 1

Scavenger Hunt in the Wetlands



How many of the following items can you collect in 30 minutes? Search for these items by yourself, in competition with a friend, or in teams of two or three. Carry your collection in a plastic bag.

1. One land insect
2. One aquatic insect
3. An object showing evidence of a bird
4. An object showing evidence of humans
5. An object showing evidence of a nonhuman mammal
6. An object showing evidence of a fungus
7. A leaf from a dominant emergent plant
8. A leaf from a dominant floating plant
9. A leaf from a dominant submergent plant
10. A leaf from a dominant land plant
11. A seed
12. A sample of anaerobic mud
13. A sample of aerobic mud
14. A sample of bedrock

If you need help with terms used above, see the Glossary.

Activity Packet 3
Field Trip Task Card 2

Use a Key to Identify the Kinds of Wetlands and Deep Water Habitats

The Fish and Wildlife Service has prepared a classification of wetlands and deep water habitats in the United States. The everyday group of types of wetlands--marshes, swamps, and bogs--is not precise enough for modern ecologists. The modern classification scheme divides wetlands and deepwater habitats into five systems: marine, estuarine, riverine, lacustrine, and palustrine. These systems are divided into classes. If you need help understanding some of the terms used here, see the Glossary.

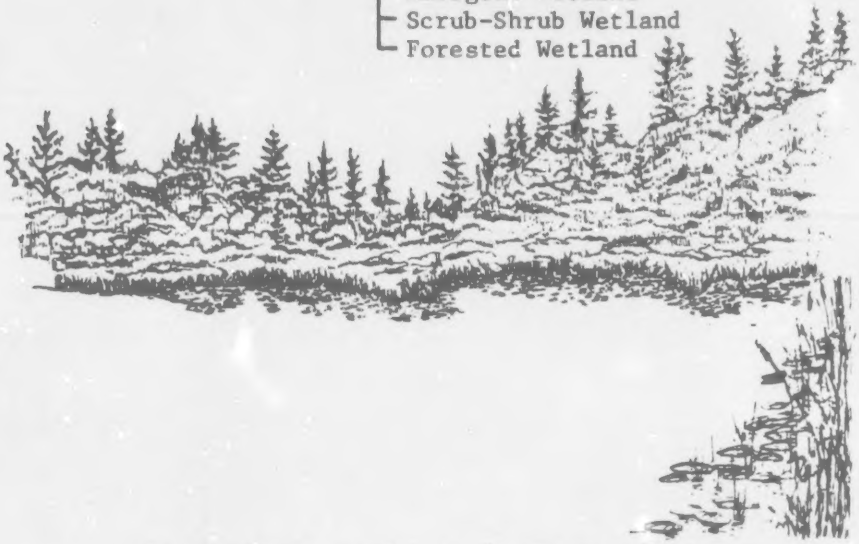
Wetlands and Deep Water Habitats*

System	Class
Marine	Rock Bottom
	Unconsolidated Bottom
	Aquatic Bed
	Reef
	Rocky Shore
	Unconsolidated Shore
Estuarine	Rock Bottom
	Unconsolidated Bottom
	Aquatic Bed
	Reef
	Streambed
	Rocky Shore
	Unconsolidated Shore
	Emergent Wetland
	Scrub-Shrub Wetland
	Forested Wetland

---

*Adapted from U.S. Dept. of the Interior Fish and Wildlife Service, Classification of Wetlands and Deepwater Habitats of the United States. December, 1979.

- Riverine
  - Rock Bottom
  - Unconsolidated Bottom
  - Aquatic Bed
  - Rocky Shore
  - Unconsolidated Shore
  - Emergent Wetland
  - Streambed
- Lacustrine
  - Rock Bottom
  - Unconsolidated Bottom
  - Aquatic Bed
  - Rocky Shore
  - Unconsolidated Shore
  - Emergent Wetland
- Palustrine
  - Rock Bottom
  - Unconsolidated Bottom
  - Aquatic Bed
  - Unconsolidated Shore
  - Moss-Lichen Wetland
  - Emergent Wetland
  - Scrub-Shrub Wetland
  - Forested Wetland



This wetland system is "Lacustrine" because the water is fresh and not flowing nor influenced by ocean tides. Plants that grow out from the substrate cover less than 30% of the area. The wetland class is "emergent wetland" because the vegetation includes perennial water plants.

On the next card is a key. Use the key at a wetland to determine its system and class. Definitions of the following terms will help you with the key:

Salinity
Emergents
Basin
Catchment
Bedrock

Subtidal
Perennial
Pioneering
Nonvascular
Splash Zone

Artificial Keys to the Systems and Classes

Keys to the Systems

1. Water influenced by oceanic tides, and salinity due to ocean derived salts 0.5 parts per thousand or greater.
   2. Semi-enclosed by land, but with open, partly obstructed, or sporadic access to the ocean. Salinity wide-ranging because of evaporation or mixing of seawater with fresh water running off from land. . . . . ESTUARINE
   2. Little or no obstruction to open ocean present. Salinity stable, little mixing of water with runoff from land. 3
      3. Emergents, trees, or shrubs present. . . . . ESTUARINE
      3. Emergents, trees, or shrubs absent. . . . . MARINE
1. Water not influenced by oceanic tides, or if influenced by oceanic tides, salinity less than 0.5 parts per thousand.
   4. Persistent emergents, trees, shrubs, or emergent mosses cover 30% or more of the area area. . . . . PALUSTRINE
   4. Persistent emergents, trees, shrubs, or emergent mosses cover less than 30% of substrate but nonpersistent emergents may be widespread during some seasons of the year. 5
      5. Situated in a channel; water, when present, usually flowing . . . . RIVERINE
      5. Situated in a basin, catchment, or on level or sloping ground; water usually not flowing. 6
         6. Area 20 acres or greater. . LACUSTRINE
         6. Area less than 20 acres. 7
            7. Wave-formed or bedrock shoreline feature present or water depth 2 m or more . . . . . . LACUSTRINE
            7. No wave-formed or bedrock shoreline feature present and water less than 2 m deep. . . PALUSTRINE

Keys to the Classes

1. During the growing season of most years, area cover by vegetation is less than 30%.
   2. Substrate is a ridge or a mound formed by colonization of sedentary invertebrates (corals, oysters, tube worms). . . . . . .REEF
   2. Substrate of rock or various sized sediments often occupied by invertebrates but not formed by colonization of sedentary invertebrates. .3
      3. Water subtidal, permanently flooded, intermittently exposed, or semipermanently flooded. Substrate usually not soil . . 4

Substrate
Sedentary

Vascular
Dominants

If you are unfamiliar with any of these terms, look them up in the Glossary.

4. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area . . . . ROCK BOTTOM

4. Substrate of organic material, mud, sand, gravel, or cobbles with less than 75% area cover of stones, boulders, or bedrock . . . UNCONSOLIDATED BOTTOM

3. Water irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. Substrate often a soil. 5

5. Contained within a channel that does not have permanent flowing water (i.e., intermittent subsystem of Riverine System or intertidal system of Estuarine or Marine Systems). . . .STREAMBED

5. Contained in a channel with perennial water or not contained in a channel. 6

6. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% of more of the area. . . . . .ROCKY SHORE

6. Substrate of organic material, mud, sand, gravel, or cobbles; with less than 75% of the cover consisting of stones, boulders, or bedrock. . . .UNCONSOLIDATED SHORE

1. During the growing season of most years, percentage of area covered by vegetation 30% or greater.

7. Vegetation composed of pioneering annuals or seedling perennials, often not water plants, occurring only at time of substrate exposure.

8. Contained within a channel that does not have permanent flowing water. . . . . STREAMBED (VEGETATED)

8. Contained within a channel with permanent water, nor not contained in a channel . . . . . UNCONSOLIDATED SHORE (VEGETATED)

7. Vegetation composed of perennial water plants such as algae, bryophytes, lichens, or tracheophytes.

9. Vegetation composed predominantly of nonvascular species.

10. Vegetation large algae, mosses, or lichens growing in water or in the splash zone of shores. . . AQUATIC BED

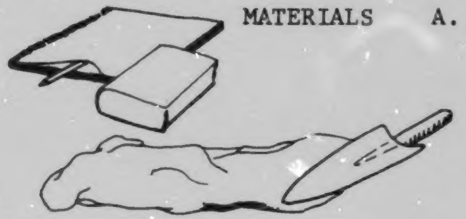
10. Vegetation mosses or lichens usually growing on organic soils and always outside the splash zone of shores . . . . . . MOSS-LICHEN WETLAND

9. Vegetation composed predominantly of vascular species.

11. Vegetation herbaceous
    12. Vegetation emergents . . . . EMERGENT WETLAND
    12. Vegetation submergent, floating-leaved, or floating . . AQUATIC BED
11. Vegetation trees or shrubs. 13
    13. Dominants less than 6 m tall . . . . SCRUB-SHRUB WETLAND
    13. Dominants 6 m tall or taller . . . . FORESTED WETLAND

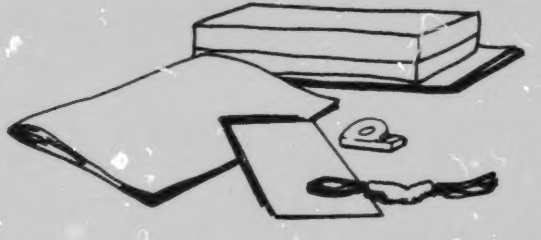
Activity Packet 3
Field Trip Task Card 3

Make a Wetlands Plant Collection



MATERIALS A. For the field trip

1. Plastic bag
2. Trowel
3. Notebook and pencil
4. Guide book to plants

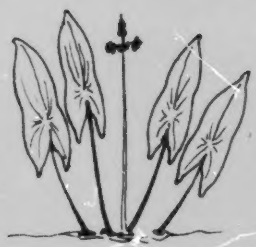


B. For the lab work

1. Two boards 12" x 18" (or plant press)
2. Newspapers
3. Blotter (11½" x 16½" or paper towels)
4. Corrugated ventilators (11½" x 16½")
5. Weights (box of stones or bag of sand) or straps
6. Plant display sheets (11½" x 16½")
7. Transparent tape

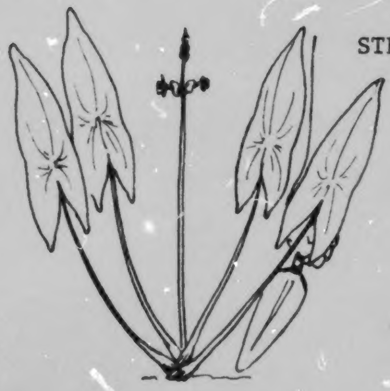
STEP 1 Find a plant that interests you. Find out its name. Write in your notebook things you can observe.

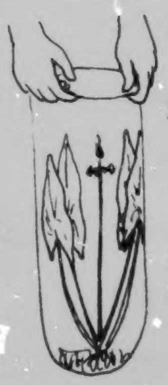
1. What is its name?
2. Where does it grow?
3. What color is it?

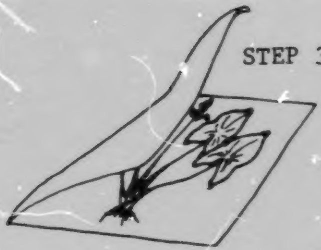


STEP 2 Collect the plant - make sure the plant is not rare and protected.

1. Carefully dig or pull the plant out of the soil.
2. Carry it back with other plants in a plastic bag.





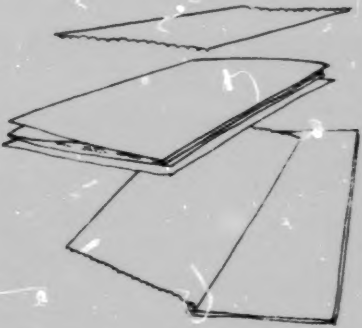


STEP 3

1. Lay out the plant between the halves of a folded newspaper.
2. Add a note with your name, date, where collected, and name of plant if known.
3. Bend part of plant to fit 11½" x 16½" size.

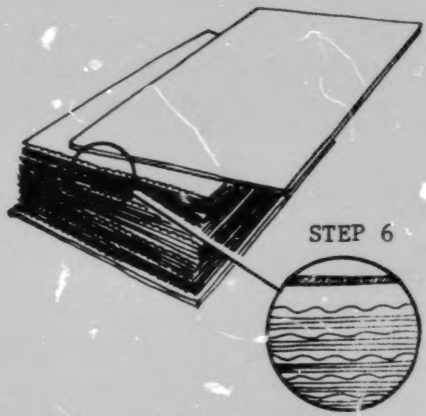
STEP 4

Place blotter driers, paper toweling, or more newspaper under and on top of folded newspaper.



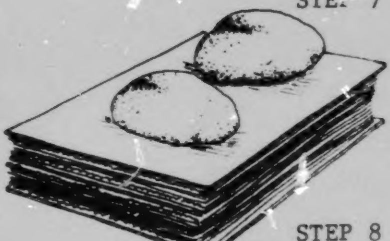
STEP 5

1. Place corrugated cardboard sheets above and below the blotter driers.
2. Place this stack on the board that forms the bottom of the press.



STEP 6

Continue to add blotter, specimens in newspaper, blotter, corrugated cardboard sheet, blotter, etc., until you have a stack no larger than ½ meter.



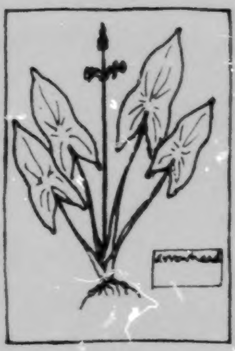
STEP 7

1. Place top of press on stack.
2. Add weight (box of stones, bag of sand) or strap the press together.
3. Change wet blotter for dry blotters every day and continue until blotter stays dry.

STEP 8

1. Mount dried plant specimens on sheets of white paper 11½" x 16½". Use transparent tape.
2. Add the label that gives name of plant, location found, date of collection, and name of collector.

You might even make a frame and turn your collection into an art object to hang on the wall.

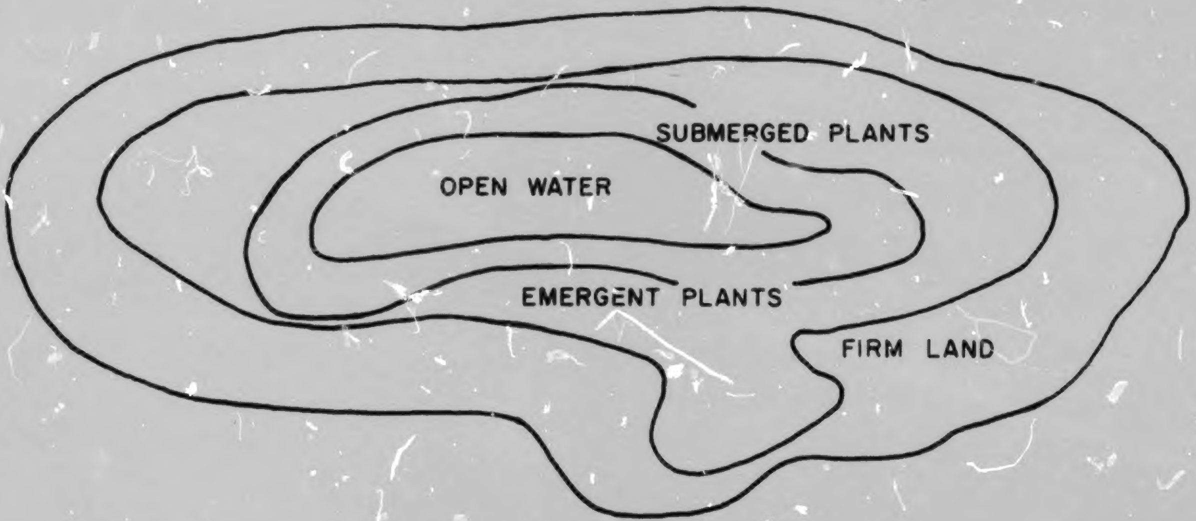


Activity Packet 3
Field Trip Task Card 4

Plant Map

The kinds of plants that grow in wetlands depend on the chemistry of the water and soil, the amount of sunlight received, the air temperatures, the water temperatures, the movement of the water. Indeed, wetlands are classified on the basis of where key types of plants grow.

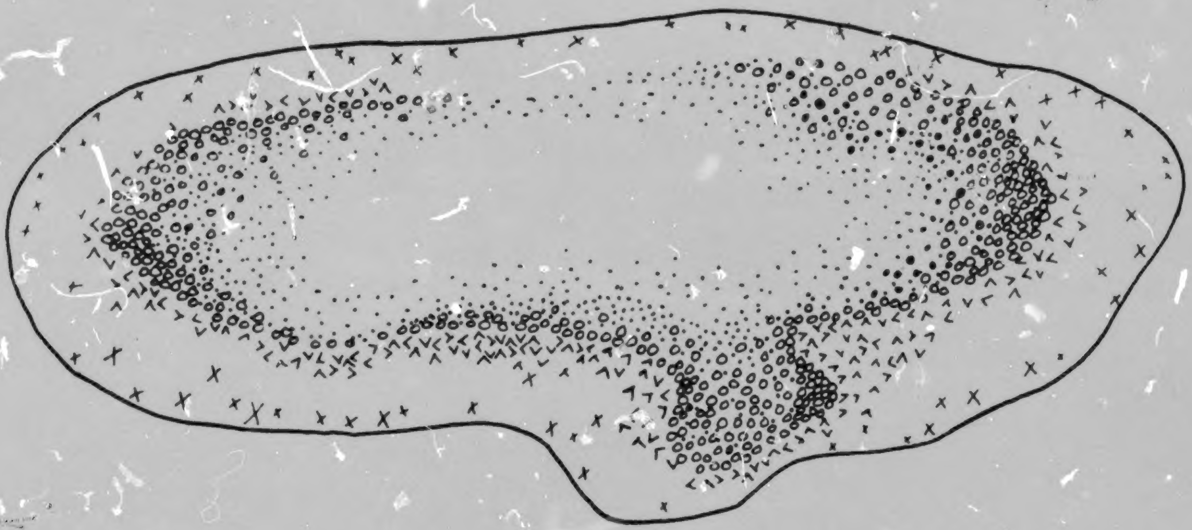
Survey your wetland and make a general sketch of the land types.


SUBMERGED PLANTS
OPEN WATER
EMERGENT PLANTS
FIRM LAND

Here is an example of a sketch. The wetland is viewed from above as if it were a map.

x — WILLOW TREES
< — SEDGES
o — CATTAILS
● — WATER LILIES

Choose one plant from each land type. Select the plant that seems to be the best indicator of the land type. For example, you may pick cattails for soggy soil, water lilies for open water, and willow for firm land. Using dots, X's, circles, or other symbols, make a plant map of the wetland.



SUMMARY QUESTIONS

1. What specific environmental conditions appear to be important to the growth of your indicator plant?

2. How are your indicator plants adapted for life in their zone?

3. Has the growth and distribution of plants been affected by pollution? How?

Activity Packet 3
Field Trip Task Card 5

Wet Pets

THE PROCEDURE

Select an organism of the wetland.

Observe the organism.

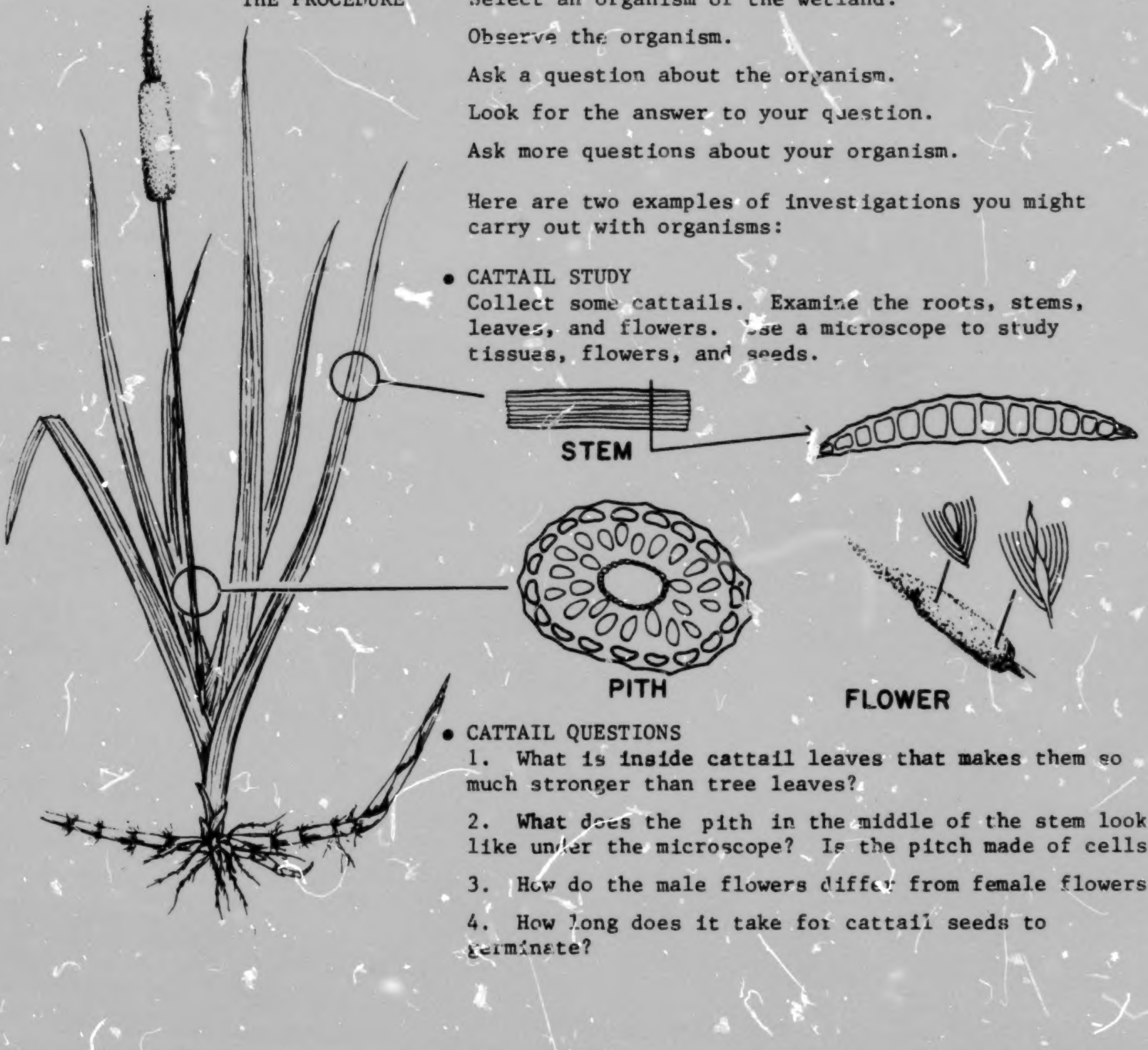
Ask a question about the organism.

Look for the answer to your question.

Ask more questions about your organism.

Here are two examples of investigations you might carry out with organisms:

- CATTAIL STUDY
  Collect some cattails. Examine the roots, stems, leaves, and flowers. Use a microscope to study tissues, flowers, and seeds.



- CATTAIL QUESTIONS
  1. What is inside cattail leaves that makes them so much stronger than tree leaves?

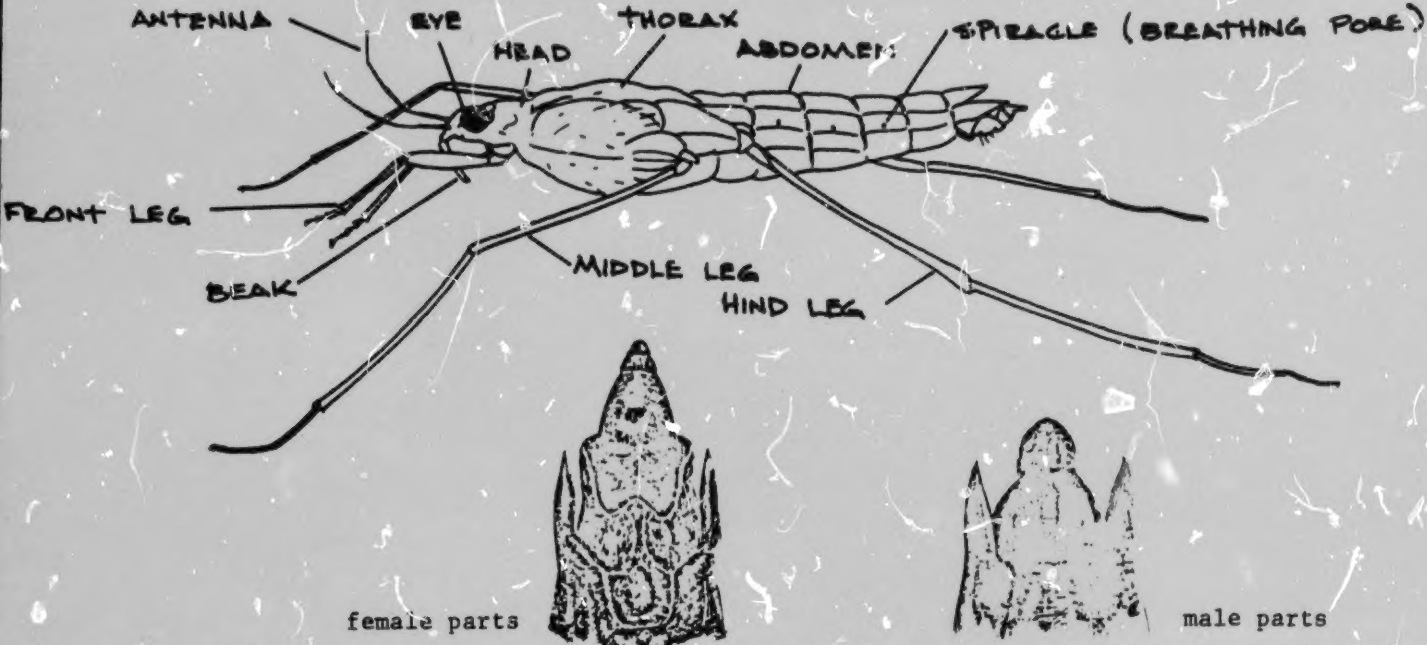
  2. What does the pith in the middle of the stem look like under the microscope? Is the pitch made of cells?

  3. How do the male flowers differ from female flowers?

  4. How long does it take for cattail seeds to germinate?

Water Strider Study

Use an insect net to collect some male and female water striders from the surface of a pond. Cover the bottom of an aquarium with wet paper toweling. Add the water bugs. Place a lid over the aquarium.


ANTENNA
EYE
HEAD
THORAX
ABDOMEN
SPIRACLE (BREATHING PORE)
FRONT LEG
BEAK
MIDDLE LEG
HIND LEG
female parts
male parts

One at a time add different kinds of insects that you have collected from a freshwater wetland.

Water Strider Questions

1. Which insects do the striders eat? Which do the striders not eat?

2. How do the mouth parts of striders work as they feed?

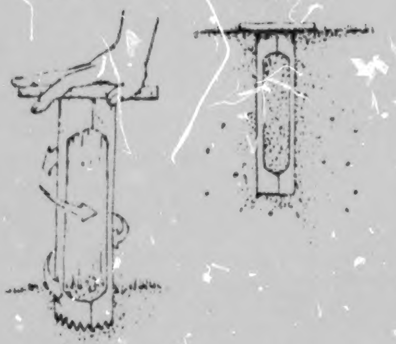
3. How long does it take for the eggs of striders to hatch?

4. How do water striders manage to "float" on the surface of water?

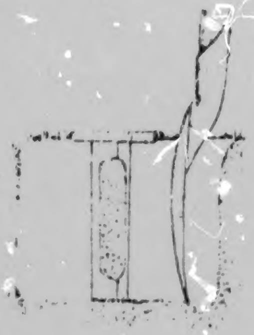
Activity Packet 3
Field Trip Task Card 6

Wetland Soil

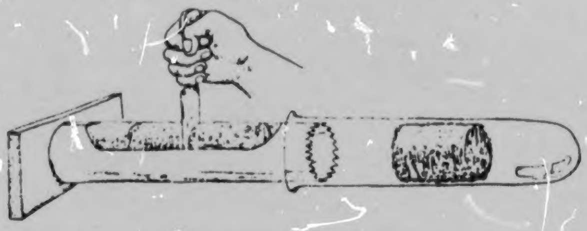
Obtain samples of soil in a wetland. Use a 25 cm soil drill or metal pipe cut open on one side.

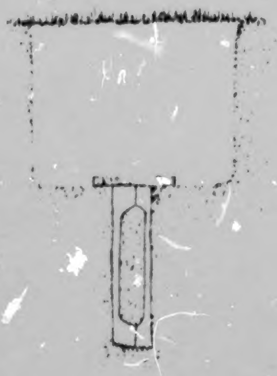


Dig out a hole around the core with a shovel.



Use a spatula to unload the core. Place the core by sections into a glass cylinder or tray.

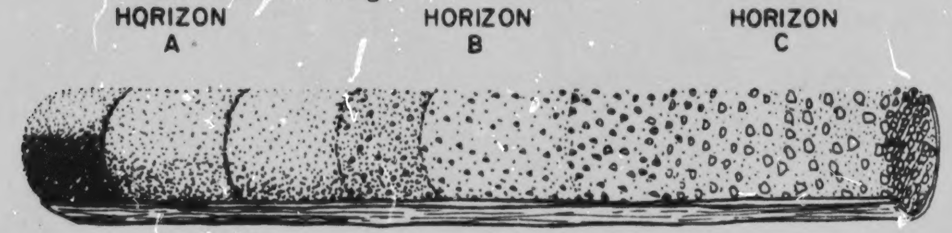




Take a second sample of soil from the bottom of the 25 cm deep hole.

Repeat all steps 1-5 until you have taken 3 or 4 cores.

Line up your 3 or 4 cores in their natural order. Make a sketch of the complete picture of the soil. Each different-looking layer of soil is a "horizon." A core with several different horizons is a "profile." Take your soil samples to the laboratory for examination and testing.



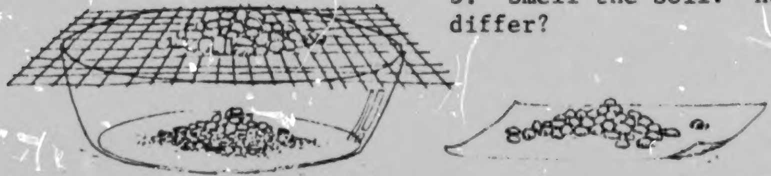
SOIL PROFILE

QUESTIONS

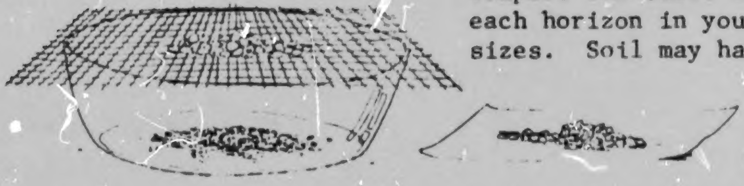
1. What organisms did you find in the core?

2. How deep into the soil did the plant roots penetrate?

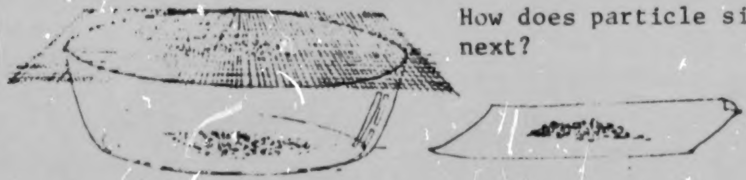
3. Smell the soil. How do the odors of the horizons differ?

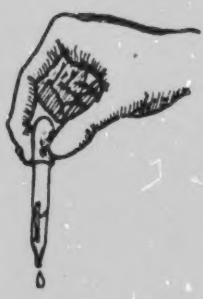


Compare the sizes of particles in samples of soil from each horizon in your profile. Use screens of different sizes. Soil may have to be dried before using screens.



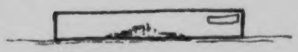
How does particle size change from one horizon to the next?



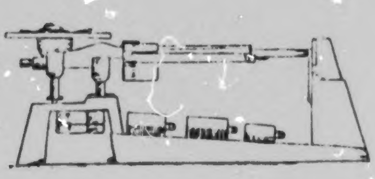


Test the acidity of the soil by adding 10 ml of distilled water to about 10 grams of soil. Mix and test with pH paper after about 10 minutes.

How does the pH of soil in each horizon compare?

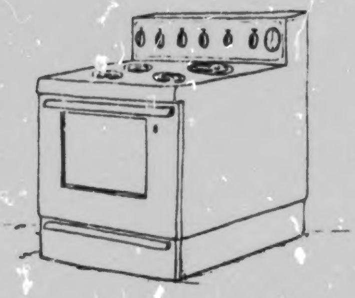


Find out how much water is in the soil. Weigh out 10 grams of soil. Dry the sample in an oven at about 250°F for 2 hours. Weigh the dried sample. Calculate the percentage of water in soil by the formula:

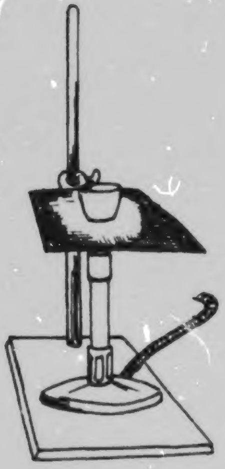


$$\frac{10 \text{ grams} - \text{dry weight}}{10 \text{ grams}} \times 100 = \qquad \%$$

Is the percentage of water in each horizon the same? How much do they differ?



Find out how much organic material is in soil. Weigh out a portion of air-dried soil. Cook it in a crucible (uncovered) until red hot and no more steam is given off. Allow to cool. Reweigh and calculate the percentage of organic material.



$$\frac{\text{Dry weight} - \text{weight after heating}}{\text{Dry weight}} \times 100 = \qquad \%$$

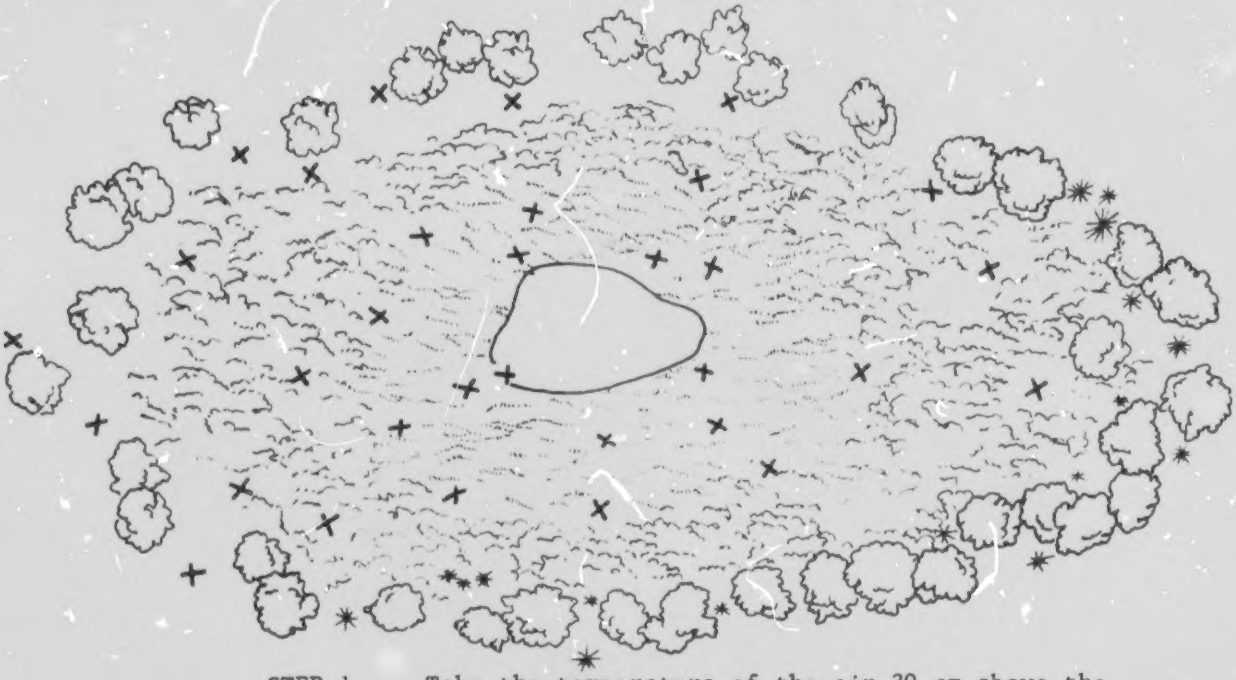
Is the percentage of organic material in each horizon the same? How much do they differ?

Activity Packet 3
Field Trip Task Card 7

Temperature Map

Draw a map of the wetland including some of the high land and/or water that surrounds the habitat.

Clark Bog
Thursday, 14 May 1981, 10:30 hrs.



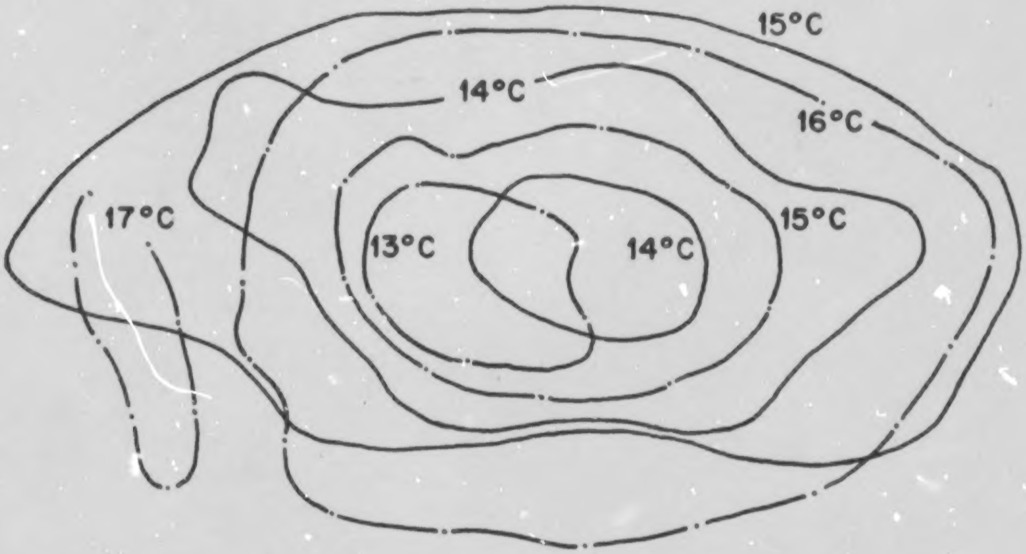
STEP 1 Take the temperature of the air 30 cm above the surface at ten or more locations in each region of the habitat. (In the example of the bog above, readings of air temperatures were taken at locations marked "X".) Record in blue these temperatures on the map.

Continue to take air temperatures in other regions of the wetland. Similarly record these temperatures in their corresponding locations on the map.

STEP 2 Using the same thermometer, measure the temperatures of the water and mud at the same depths below their surfaces. Attach a string to the thermometer so that the depth of the readings will be constant. Again, take plenty of readings at different locations throughout the wetland.

Record water temperatures on your map in red and mud temperatures in black at the location of the readings.

Draw a temperature map of the wetlands. Temperature maps attempt to enclose all areas of the same temperature with a line. The enclosing lines of one temperature are "isotherms". Draw air temperature isotherms in blue, water isotherms in red, and mud isotherms in black.



Temperatures of Mud: Clark Bog 14 May 1983, Noon

1. What factors affect the distribution of heat in the wetlands?

1a. Why are these factors important?

2. Would the temperature map of the wetland change during the night? What would it look like on a hot cloudless summer afternoon?

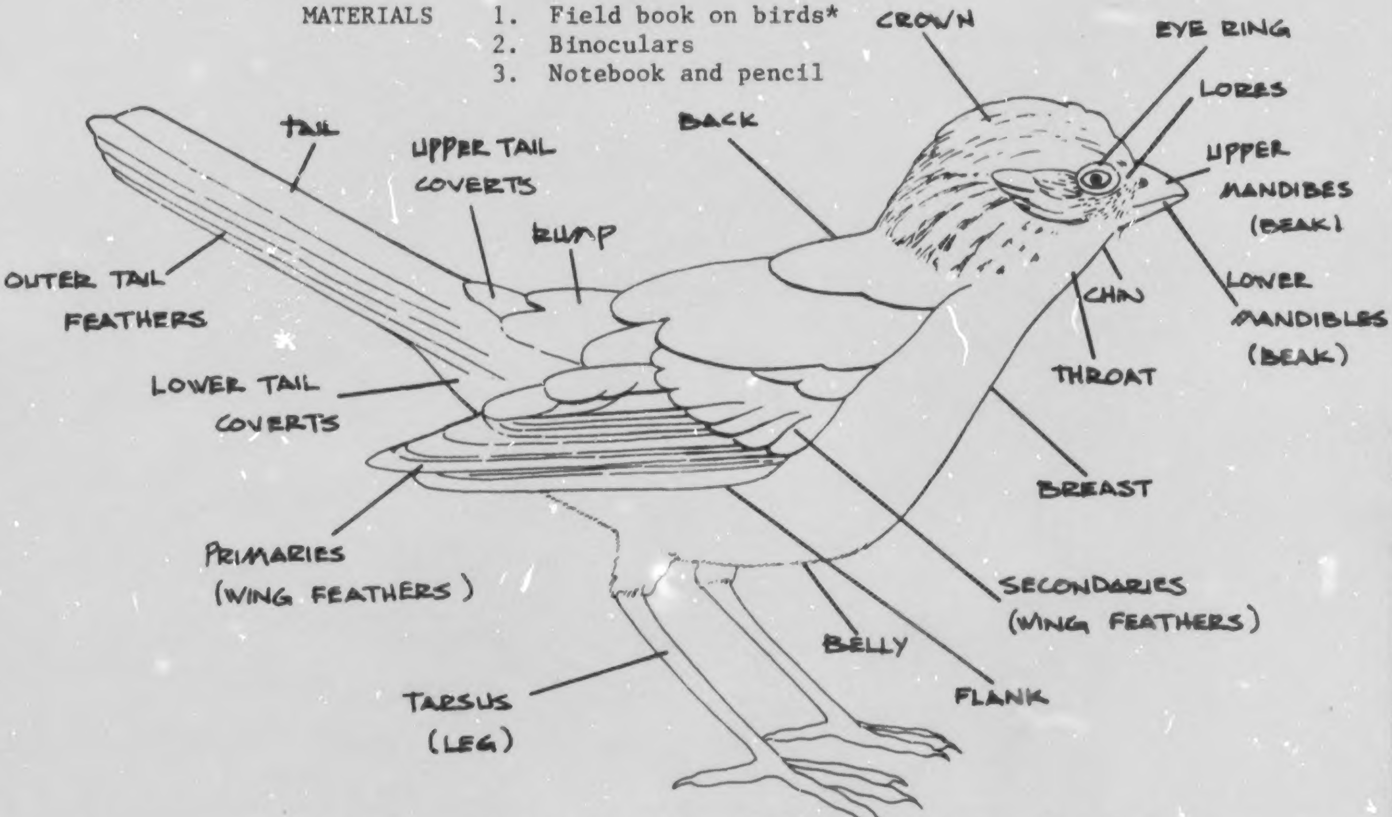
Activity Packet 3
Field Trip Task Card 8

Bird Watching I
Identifying Birds

How many different kinds of birds can you spot in the wetlands?

What are the names of the birds?

MATERIALS
1. Field book on birds*
2. Binoculars
3. Notebook and pencil


CROWN
EYE RING
LORES
UPPER MANDIBES (BEAK)
LOWER MANDIBLES (BEAK)
TAIL
UPPER TAIL COVERTS
BACK
RUMP
OUTER TAIL FEATHERS
CHIN
THROAT
LOWER TAIL COVERTS
BREAST
PRIMARIES (WING FEATHERS)
SECONDARIES (WING FEATHERS)
BELLY
TARSUS (LEG)
FLANK

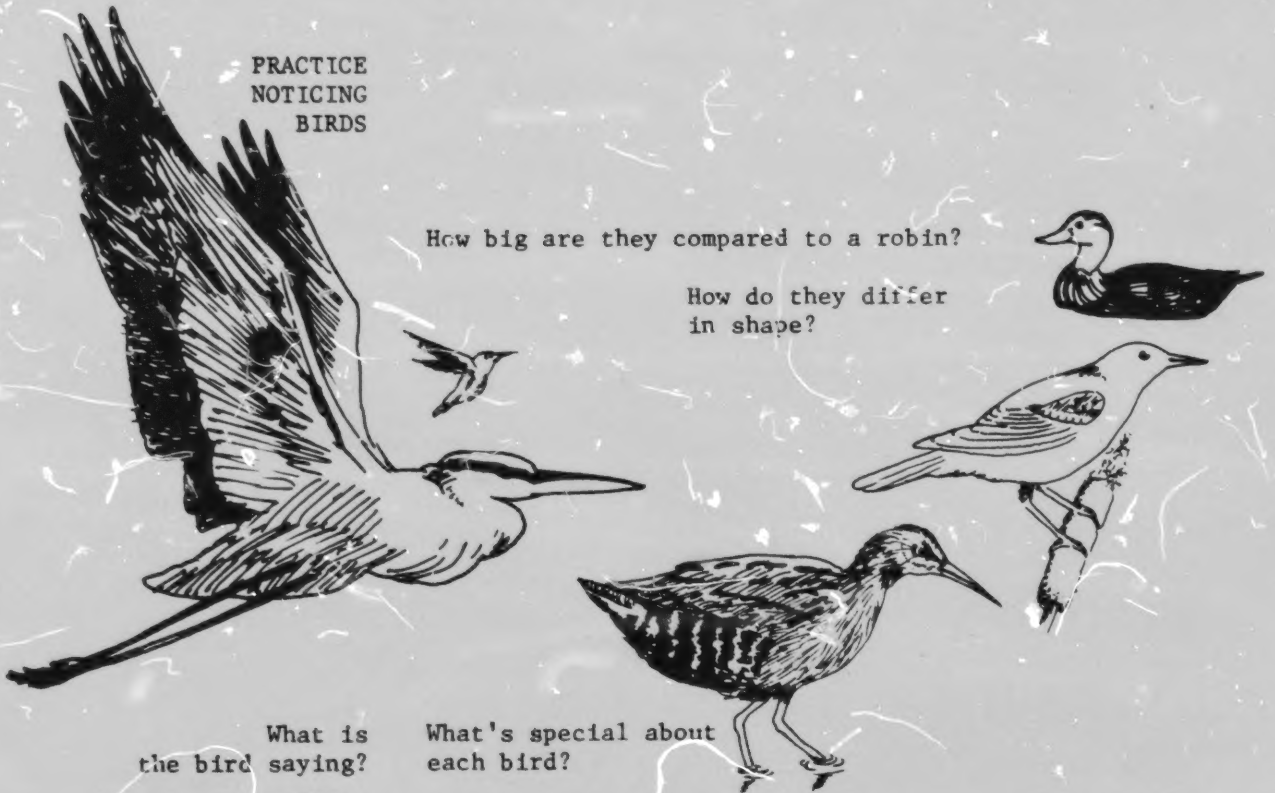
Learn the parts of a bird. Look for these parts on living birds in the outdoors.

*Here are a few suggestions for field books on birds.
1. A Guide to Field Identification. Birds of North America. C. Robbins, B. Bruun, and H. Zim. Golden Press, New York, 1966.
2. A Field Guide to the Birds. Eastern Land and Water Birds. Roger Tory Peterson. Houghton Mifflin Company, Boston, 1947.
3. A Field Guide to Western Birds. Roger Tory Peterson. Houghton Mifflin Company, Boston, 1961.

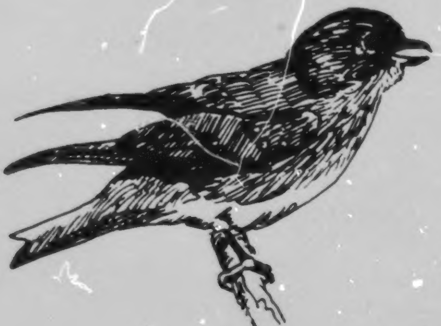
PRACTICE NOTICING BIRDS

How big are they compared to a robin?

How do they differ in shape?

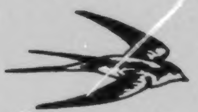


What is the bird saying?

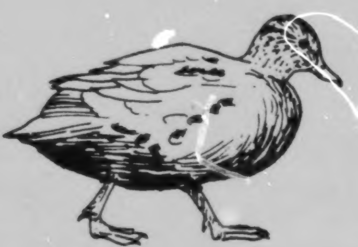


What's special about each bird?

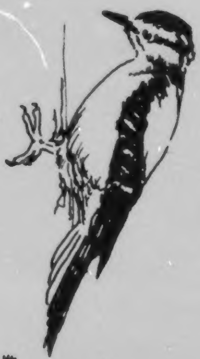
forked tail



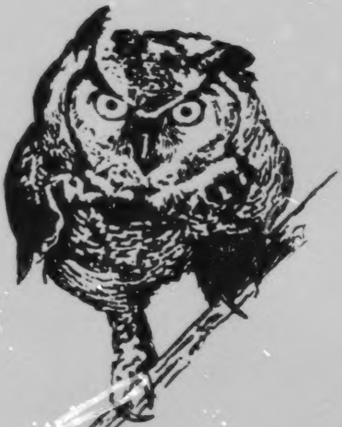
walks in circles



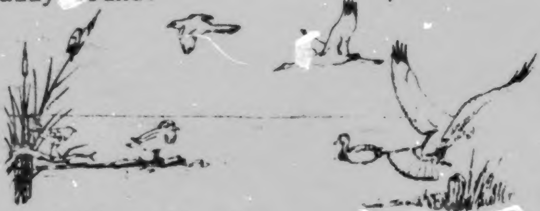
runs up and down a tree



Do they watch you?



Where are they usually found?

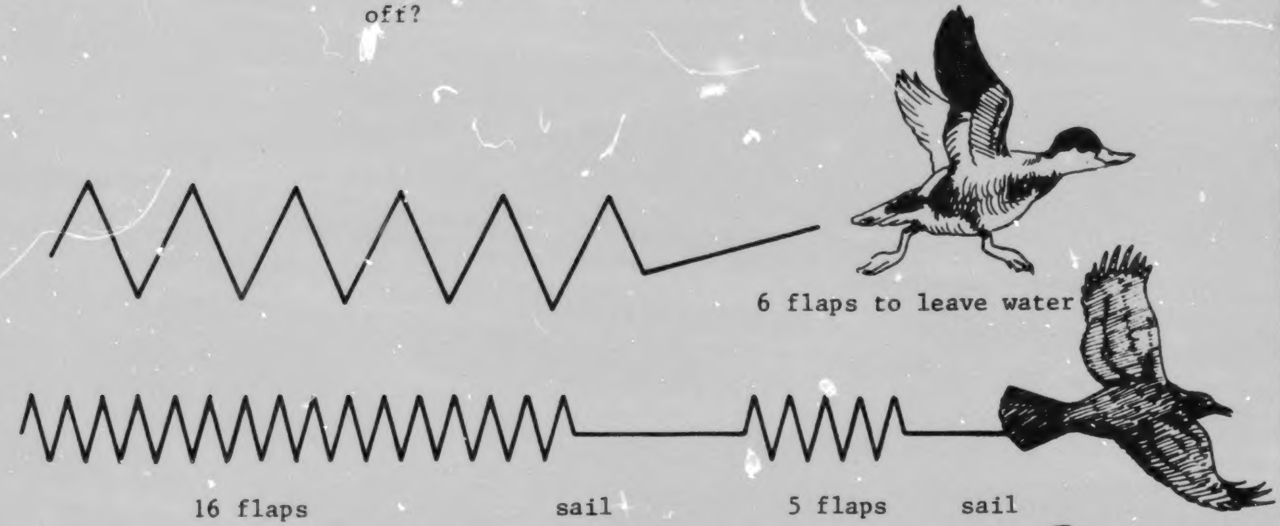


Now make a list of all the birds that you can see and name in 15 minutes.

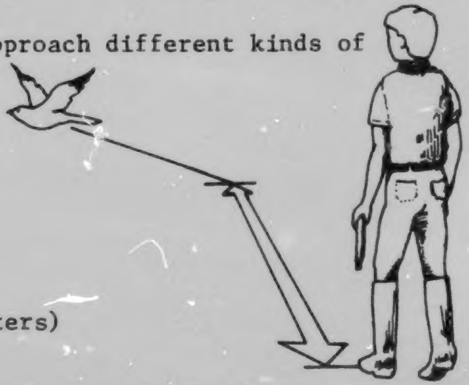
Activity Packet 3
Field Trip Task Card 9

Bird Watching II
Special Bird Study Projects

How do birds in your wetland differ in how they take off?


6 flaps to leave water
16 flaps
sail
5 flaps
sail

How close can you approach different kinds of birds before they fly off?

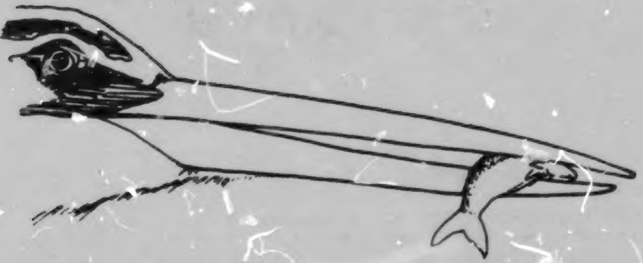


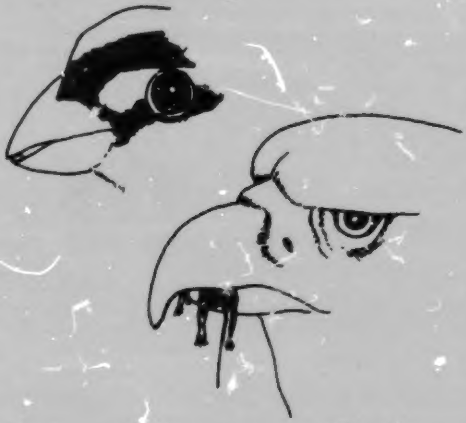
Fright Distance (meters)

Trials

Bird	1	2	3	4	5	6	7	8	9	10	Average
Great Blue Heron											
Redwing Blackbird											

What foods do the birds of the wetland eat?

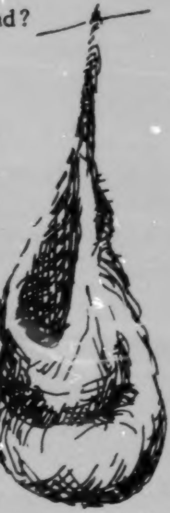




Draw pictures of the beaks of birds at work catching and holding food in your wetland.

BECOME A
NIDOLOGIST
(a scientist who
studies nests)

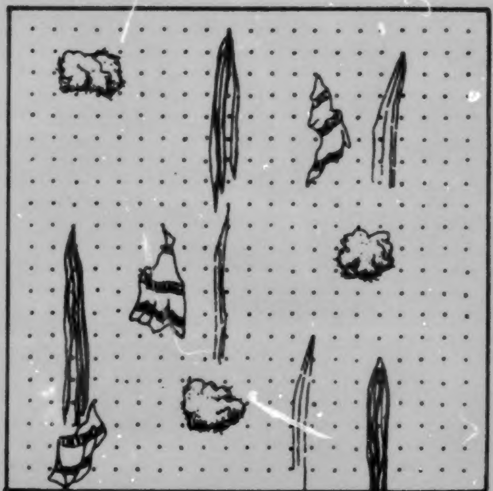
How many different kinds of nests can you find?



How many eggs, or young, live in one nest?

What are nests made of?

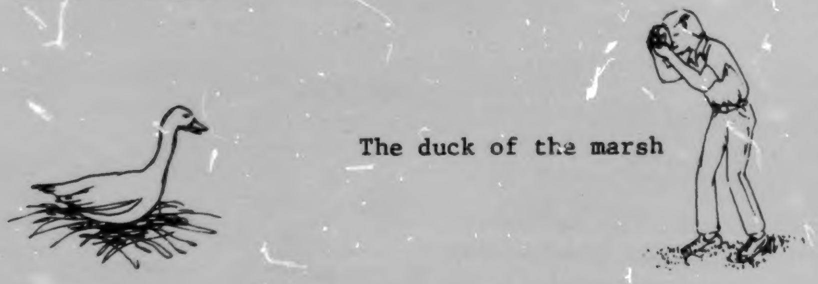
Set out a selection of materials nesting birds might select from. Watch the board with field glasses. Which materials are preferred by which birds.



Activity Packet 3
Field Trip Task Card 10

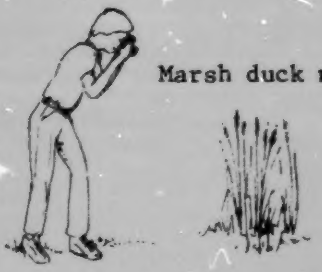
Photography

Take a camera to a wetland and shoot the story . . . about an animal.

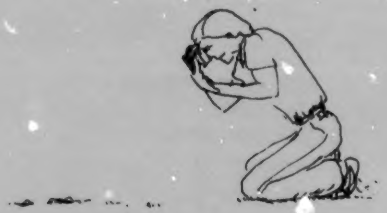


The duck of the marsh

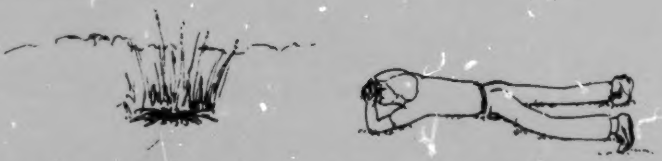
Tracks of the marsh duck



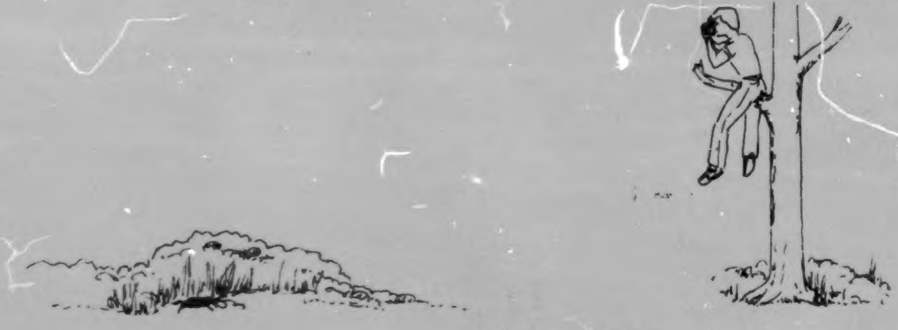
Marsh duck morsels



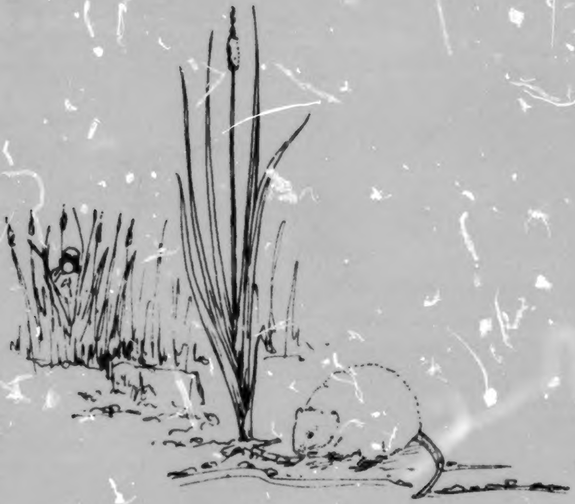
Marsh duck nest



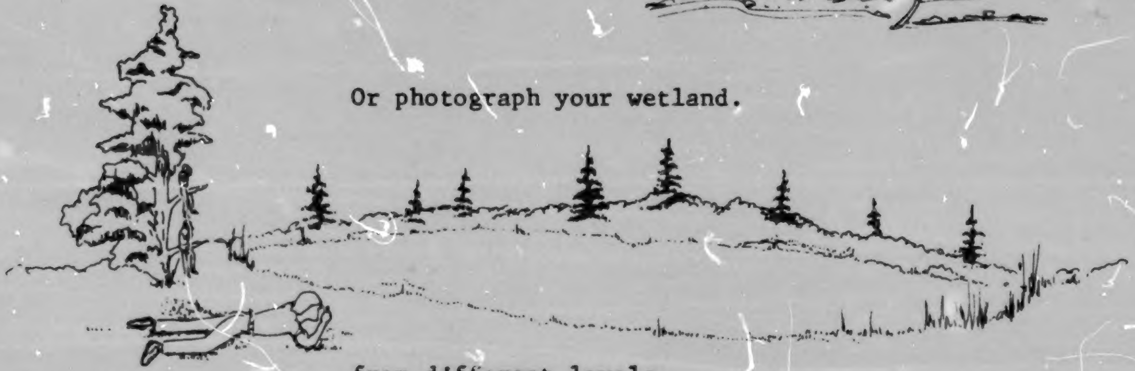
Homeland of marsh ducks



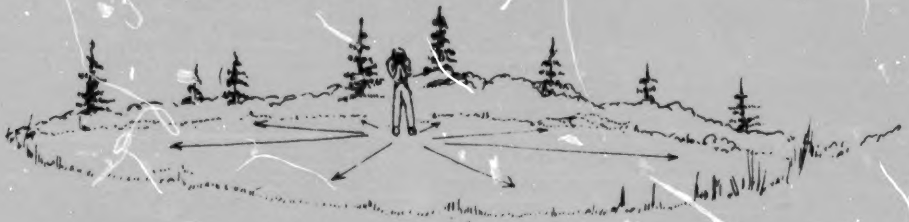
Or tell a story about how plants and animals interact in the wetland.



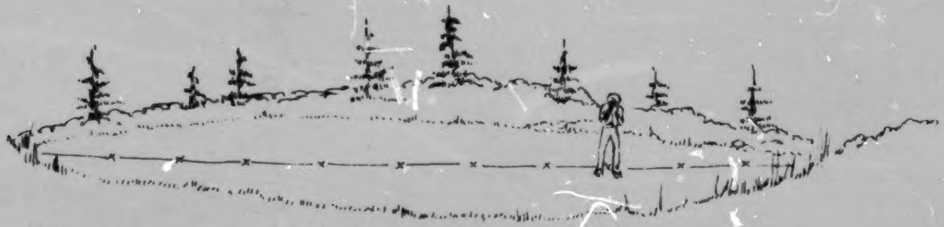
Or photograph your wetland.



from different levels



in all directions around a point



at points along a line

Activity Packet 3
Field Trip Task Card 11

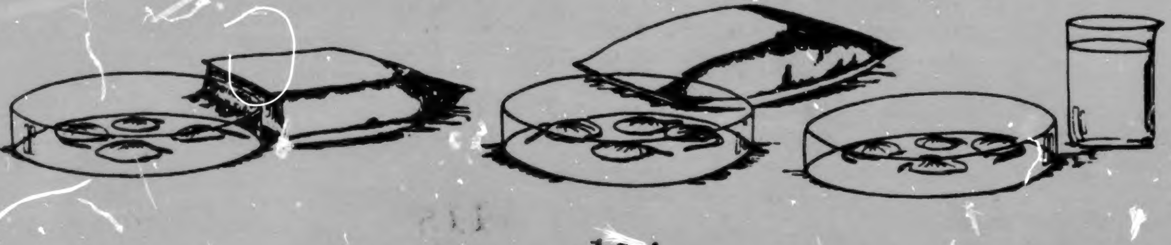
How fast does Duckweed reproduce?

Duckweed is a small flowering plant that floats on the surface of quiet freshwaters. It is common to the waters of freshwater marshes. Leaflike fronds are exposed to light at the surface of the water. A single rootlet grows down into the water. Duckweed reproduce asexually by the formation of daughter fronds. When growing conditions are favorable, budding occurs rapidly.

STEP 1 Collect some duckweed from a wetland, an aquarium, or a pond.

STEP 2 Place four duckweed plants in each of four culture dishes:

a. In dish #1 add 100 ml of distilled water.
b. In dish #2 add 100 ml of a 0.1% solution of 5-10-5 fertilizer.
c. In dish #3 add 100 ml of cow manure solution. (Bake 10 g of cow manure for 4 hours. Soak the cow manure in 2000 ml of tap water.)
d. In dish #4 add 100 ml of water from the environment in which they were collected.



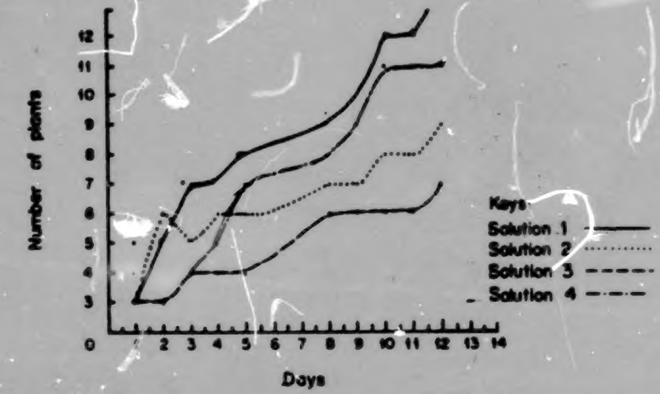
STEP 3 If you wish, add an additional culture dish with a test nutrient solution of your own invention.

STEP 4 Cover the culture dishes. Then place them in a lighted area. Keep them out of direct sunlight.

STEP 5 Each day for two weeks count the number of duckweed plants in each dish. Record the number in a table like the one below.

	Days													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dish 1	3	5	7	7	8	No count		9	10	12	12	14	No count	
Dish 2	3	6	5	6	5	(weekend)		7	7	8	8	9	(weekend)	
Dish 3	3	3	4	4	4			6	6	6	6	7		
Dish 4	3	3	4	5	7			8	9	11	11	11		

STEP 6 Plot the rates of population growth for the plants in each dish on a graph like the one below.



SUMMARY QUESTIONS

1. In which dish did you observe the greatest amount of plant reproduction? How do you explain these results?

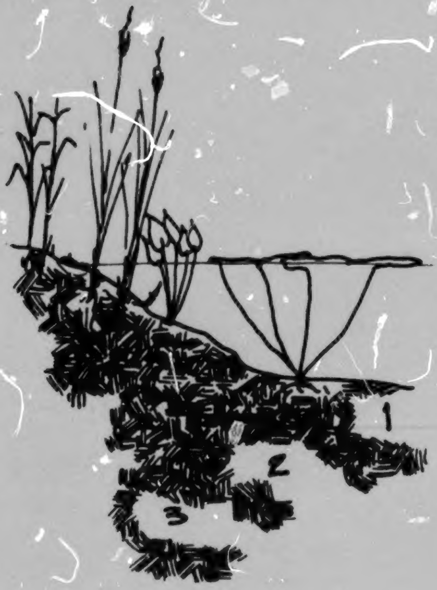
2. What factors other than the substances in each solution might affect the reproduction of duckweed?

3. Duckweed has an unusual "life form." That is, it grows on surface water, roots dangling into the water a few centimeters. Can you cite any advantages to this strange way of making a living?

4. What effect might a pond full of duckweed have on other organisms?

Activity Packet 3
Field Trip Task Card 12

Mud

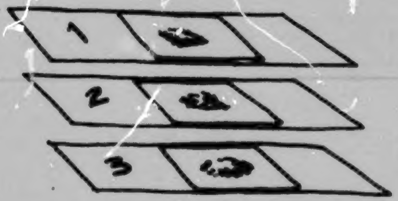


What can a microscope show you about the mud of a wetlands?

Collect samples of mud from three levels:

1. The top of the mud
2. The middle of the mud
3. The bottom of the mud

Make a thin slide of each sample of mud.

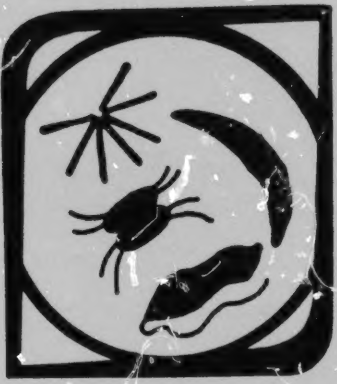


Look at each slide under a microscope.

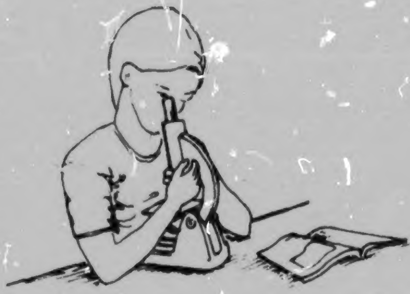
Make drawings of about 3 pieces of mud from each level.

How do samples of mud from the top, middle, and bottom levels differ?

If you mixed all the slides up could you pick out which ones belonged to which level by the contents?

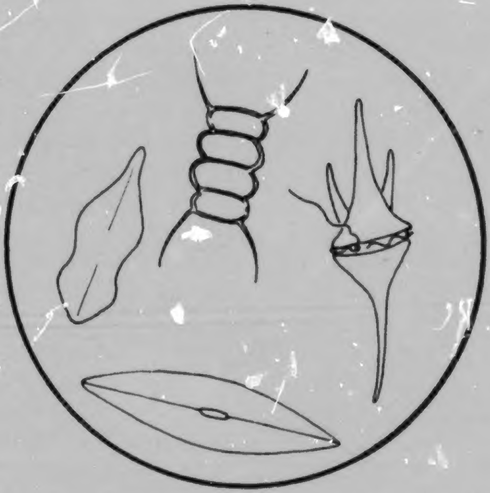


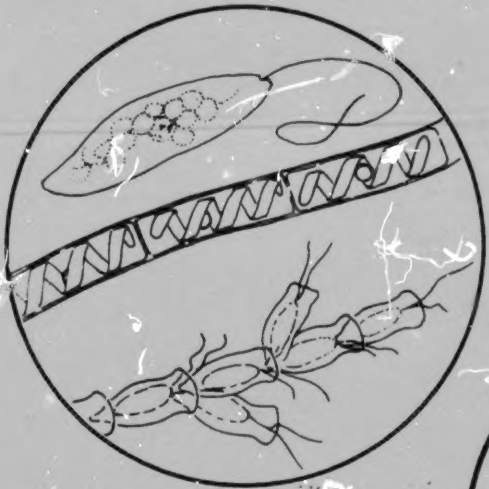
What organisms live in mud?

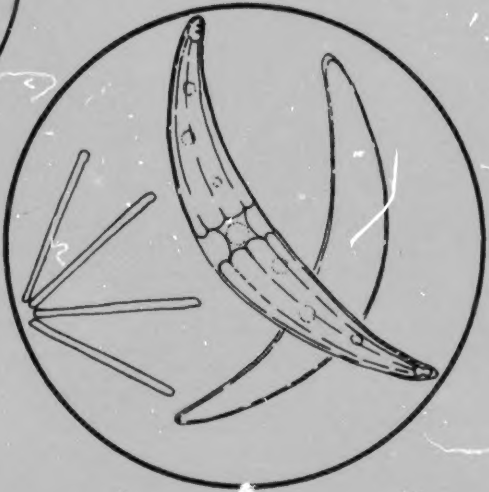


Use a microscope to explore your samples of mud.

Whenever you see something that seems to be alive, draw a picture of it.







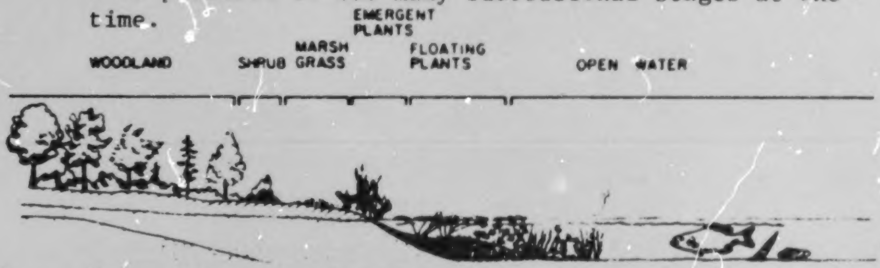
Group your drawings of organisms by color, by shapes, by size, and by the way they move.

Activity Packet 3
Field Trip Task Card 13

Succession-Freshwater Marsh

Find Successional Stages in a Wetland

Lakes, ponds, and wetlands have short lives, geologically speaking. In theory, a wetland should eventually fill in with dead plant matter. The stages in this succession occur in an orderly and predictable sequence. Different parts of a wetland may be at different stages of succession at any time. It is therefore possible to see many successional stages at one time.



SUCCESSIONAL STAGE 1	Open water and submerged aquatic plants. Plants grow under water and are usually rooted in the bottom.
SUCCESSIONAL STAGE 2	Zone of plants with floating leaves and flowers. While usually rooted on the bottom, these plants are supported on the surface by long stems or leaf petioles (leaf stems).
SUCCESSIONAL STAGE 3	Region of emergent aquatic plants. In these shallow waters the bases of such plants as cattails and arrowhead are under water while stems and leaves are above the surface of the water.
SUCCESSIONAL STAGE 4	The marsh grass zone: these grasses grow around the edges of flooded soil.
SUCCESSIONAL STAGE 5	The shrub zone: these small woody plants tolerate very damp soil and frequent flooding.
SUCCESSIONAL STAGE 6	The woodland region: the last stage in a climax forest.

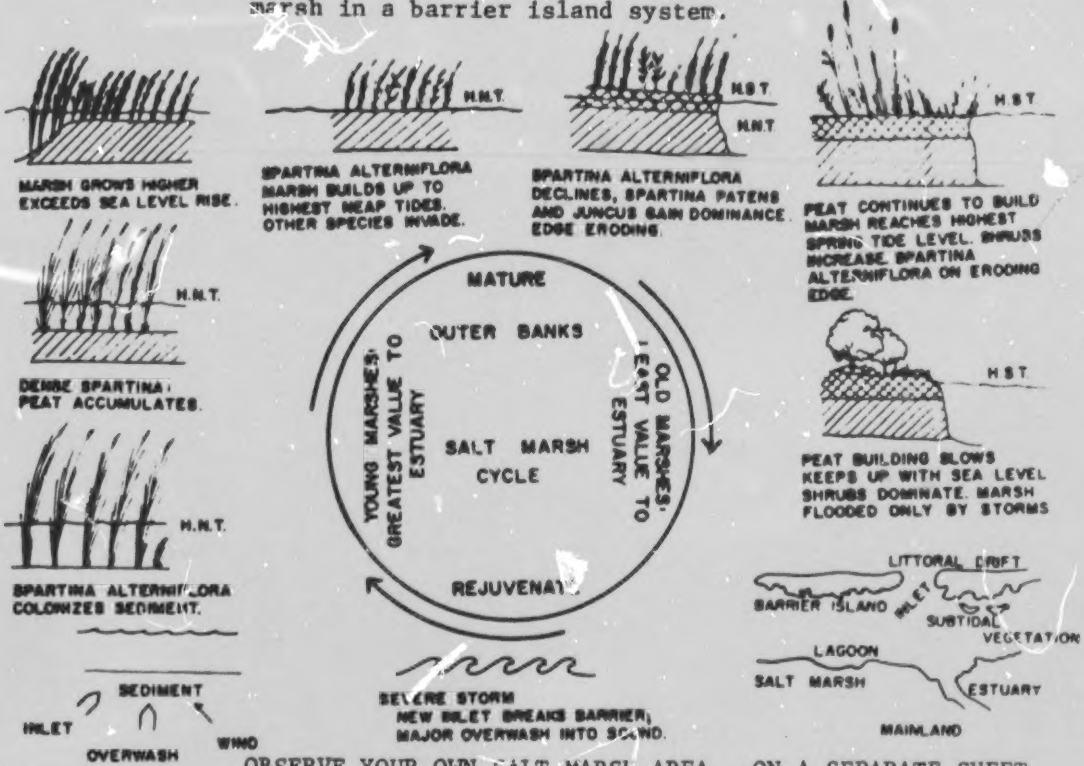
OBSERVE YOUR FRESHWATER WETLAND AREA. DESCRIBE THE APPEARANCE OF AS MANY OF THE SIX STAGES AS YOU CAN ON A SEPARATE SHEET OF PAPER.

HOW LONG WOULD YOU EXPECT EACH OF THESE SIX STAGES TO OCCUR?

Succession-Saltwater Marsh

Salt marshes go through a cycle of changes. The soil builds up as plants become established. At first the plants are almost completely submerged in salt water. As soil accumulates, less and less of the plants are submerged. Shrubs and trees may even appear in older stages. But storms eventually break down protective barriers and wash away the soils. And then the cycle of marsh development is repeated.

Here is a diagram of a theoretical cycle of a marsh in a barrier island system.


MARSH GROWS HIGHER EXCEEDS SEA LEVEL RISE.
H.N.T.
SPARTINA ALTERNIFLORA MARSH BUILDS UP TO HIGHEST NEAP TIDES. OTHER SPECIES INVADE.
H.S.T.
H.N.T.
SPARTINA ALTERNIFLORA DECLINES, SPARTINA PATENS AND JUNCUS GAIN DOMINANCE. EDGE ERODING.
H.S.T.
PEAT CONTINUES TO BUILD MARSH REACHES HIGHEST SPRING TIDE LEVEL. SHRUBS INCREASE. SPARTINA ALTERNIFLORA ON ERODING EDGE.
H.N.T.
DENSE SPARTINA; PEAT ACCUMULATES.
MATURE
OUTER BANKS
SALT MARSH CYCLE
YOUNG MARSHES; GREATEST VALUE TO ESTUARY
OLD MARSHES; LEAST VALUE TO ESTUARY
REJUVENATE
H.S.T.
PEAT BUILDING SLOWS KEEPS UP WITH SEA LEVEL SHRUBS DOMINATE. MARSH FLOODED ONLY BY STORMS
H.N.T.
SPARTINA ALTERNIFLORA COLONIZES SEDIMENT.
SEDIMENT
INLET
OVERWASH
WIND
SEVERE STORM
NEW INLET BREAKS BARRIER; MAJOR OVERWASH INTO SOUND.
LITTORAL DRIFT
BARRIER ISLAND
INLET
SUBTIDAL VEGETATION
LAGOON
SALT MARSH
ESTUARY
MAINLAND

OBSERVE YOUR OWN SALT MARSH AREA. ON A SEPARATE SHEET OF PAPER DESCRIBE THE APPEARANCE OF AS MANY OF THE STAGES YOU CAN FIND IN THE SALT MARSH.

*Figure taken from "Barrier Beaches of the East Coast" by Paul J. Godfrey, Oceanus, Vol. 19, #5, Fall 1976.

Puzzling Out a Food Web

Chapter 4
Activity Sheets

Activity Packet 4

Data Sheet

Wetland: ____________________

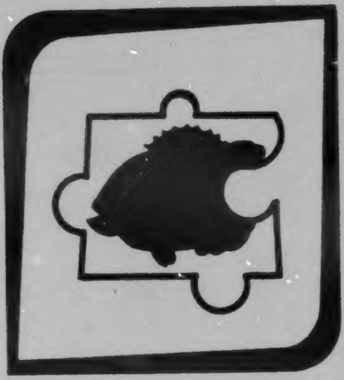
Level	Organism Removed	Effect (s)
Producer		
First-order Consumer		
Second-order Consumer		
Decomposer		

Activity Packet 4

Food Web Word Puzzle
Saltwater Marsh

A	D	G	B	K	I	L	L	I	F	I	S	H	C	A	D	E	B	F	P	G
H	C	R	R	I	J	K	C	G	F	E	L	E	D	M	N	C	B	O	E	P
Q	R	A	S	E	T	U	B	L	U	E	C	R	A	B	V	A	W	X	R	Y
Z	A	S	B	F	E	G	A	H	A	I	J	O	H	K	R	L	I	M	I	T
N	K	S	O	P	J	N	Q	U	Z	P	R	N	I	C	S	T	U	T	W	C
D	V	H	L	M	S	N	H	O	P	S	P	A	R	T	I	N	A	M	I	O
E	V	O	W	I	J	A	C	E	X	U	T	E	Y	S	R	A	Q	C	N	S
T	W	P	H	I	R	O	C	R	A	D	L	S	R	F	R	O	C	H	K	P
R	X	P	Y	Z	M	E	N	H	A	D	E	N	B	R	A	C	K	I	L	I
I	J	E	I	H	A	G	F	E	D	D	F	S	A	H	A	L	G	A	E	M
T	C	R	E	E	R	D	R	I	T	U	S	L	O	N	L	I	M	L	K	F
U	P	Q	V	U	S	T	F	O	S	P	R	E	Y	S	G	R	:	W	Z	R
S	A	L	T	M	A	R	S	H	M	O	S	Q	U	I	T	O	Y	A	X	O
T	M	C	F	I	T	O	J	A	C	L	O	M	T	A	J	V	E	R	S	G

1. Periwinkle
2. Algae
3. Detritus
4. Fiddler Crab
5. Clapper Rail
6. Heron
7. Blue Crab
8. Menhaden
9. Killifish
10. Saltmarsh Mosquito
11. Green Head Fly
12. Osprey
13. Spartina
14. Frog
15. Grasshopper



Activity Packet 4

Food Web Word Puzzle
Freshwater Marsh

T	G	M	I	N	K	P	R	M	U	V	O	W	L	A	L	X	O	N	W	I
Z	O	R	A	C	O	T	S	I	T	U	B	X	V	W	N	C	S	V	A	E
O	P	A	E	R	Y	F	D	N	N	Z	A	R	Q	O	P	A	P	S	N	O
O	C	C	L	A	F	M	B	N	B	S	A	R	T	C	A	T	T	A	I	L
P	D	C	E	K	T	J	F	O	I	L	E	K	E	Q	U	T	R	N	G	W
L	M	O	U	S	E	H	C	W	Y	D	N	C	E	F	H	C	G	D	H	A
A	B	O	A	Z	I	Y	O	L	X	A	J	W	T	K	L	L	V	R	U	T
N	T	N	S	Q	R	Q	F	R	L	R	P	O	S	L	B	T	N	T	M	E
K	U	V	P	W	X	N	Y	P	N	O	Z	N	I	M	A	B	L	J	K	R
T	D	G	E	F	O	F	O	E	G	E	H	H	D	I	S	R	J	H	C	F
O	B	C	A	G	H	T	I	Z	J	Y	D	X	W	K	S	L	V	M	U	O
N	T	O	A	P	Y	Q	S	B	R	N	Q	O	R	P	O	N	S	A	T	W
U	M	R	L	H	V	K	W	A	A	X	J	Y	W	I	H	Z	A	C	G	L
A	D	B	P	C	E	M	U	S	K	R	A	T	D	L	G	I	K	E	F	M

1. Great Horned Owl
2. Phytoplankton
3. Zooplankton
4. Minnow
5. Bass
6. Sandhill Crane
7. Waterfowl
8. Raccoon
9. Cattail
10. Mouse
11. Muskrat
12. Mink
13. Owl
14. Insect Larva
15. Dragonfly Larva

Activity Packet 4

Food Web Word Puzzle
Bog

Z	S	Y	O	P	V	E	N	U	S	F	L	Y	T	R	A	P	R	L	X	V
M	O	N	E	H	B	O	L	E	M	P	C	J	A	H	P	B	J	E	S	T
I	U	W	O	A	H	S	T	K	L	N	H	M	F	B	D	O	F	O	G	H
L	E	O	P	W	F	G	Y	O	A	J	A	A	C	A	N	G	K	P	A	H
A	S	B	G	K	S	M	O	O	S	T	E	C	G	K	H	L	E	A	N	T
D	N	I	F	E	F	H	J	C	E	L	D	G	O	N	H	E	I	R	H	S
O	A	Y	Z	A	N	B	O	C	R	M	L	F	K	A	U	M	J	D	A	U
P	K	Q	R	M	O	O	S	E	X	A	S	E	W	S	U	M	V	F	W	N
R	W	S	X	Z	T	Y	H	U	H	K	N	V	X	N	W	I	M	R	F	D
A	C	O	B	D	R	T	M	L	E	A	Q	B	P	O	F	N	G	O	X	F
O	R	N	M	N	A	N	O	Q	L	K	R	J	E	M	I	G	H	G	S	V
S	U	N	D	E	W	P	M	R	L	O	Q	E	P	R	K	R	J	S	U	S
T	F	U	L	V	S	T	W	G	U	X	H	B	E	A	R	Y	I	Z	I	O
E	D	Z	Y	X	W	C	M	O	S	Q	U	I	T	O	V	Y	B	A	T	D

1. Sphagnum Moss
2. Mosquito
3. Cranberry
4. Bear
5. Leopard Frog
6. Sundew
7. Ant
8. Venus Fly Trap
9. Snowshoe Hare
10. Hawk
11. Bog Lemming
12. Moose
13. Snake
14. Fox
15. Leather Leaf

Activity Packet 4

Food Web Word Puzzle
Swamp

A	B	W	O	O	D	P	E	C	K	E	R	E	C	D	T	L	K	C	E	J
L	K	J	A	I	M	I	H	T	R	E	E	F	R	O	G	U	H	O	G	F
F	M	O	N	T	O	P	Q	A	B	R	Q	P	R	N	S	T	R	T	U	G
V	E	S	P	F	E	W	E	X	T	D	Y	T	A	Z	U	C	R	T	D	A
G	G	R	F	I	K	R	E	S	S	P	D	J	N	H	A	C	C	O	L	B
H	I	J	B	I	K	K	S	P	A	N	I	S	H	M	O	S	S	N	L	E
M	Z	N	N	T	M	E	O	T	L	E	P	K	I	Q	J	R	A	M	S	Y
T	X	D	E	E	R	U	O	K	R	V	P	G	N	W	Q	X	W	O	Y	Z
B	V	J	S	P	I	D	E	R	K	I	L	O	G	M	V	N	R	U	U	A
C	S	U	Y	R	T	S	Z	R	X	Q	D	Q	A	W	P	P	O	T	T	D
F	R	C	A	T	F	I	S	H	V	W	O	E	X	N	Y	M	P	H	Q	E
G	H	O	U	M	Z	G	K	C	F	L	H	A	R	R	O	W	A	R	U	M
J	N	A	J	B	L	I	Z	A	R	D	D	E	I	T	H	F	G	Z	O	I
K	P	C	A	L	L	I	G	A	T	O	R	B	C	D	M	E	F	A	M	L

1. Alligator
2. Cottonmouth
3. Spider
4. Anhinga
5. Tree Frog
6. Arrow Arum
7. Turtle
8. Lizard
9. Waterstrider
10. Spanish Moss
11. Catfish
12. Woodpecker
13. Pike
14. Deer
15. Cypress Tree

Measuring the Productivity of Wetlands

Chapter 5
Activity Sheets

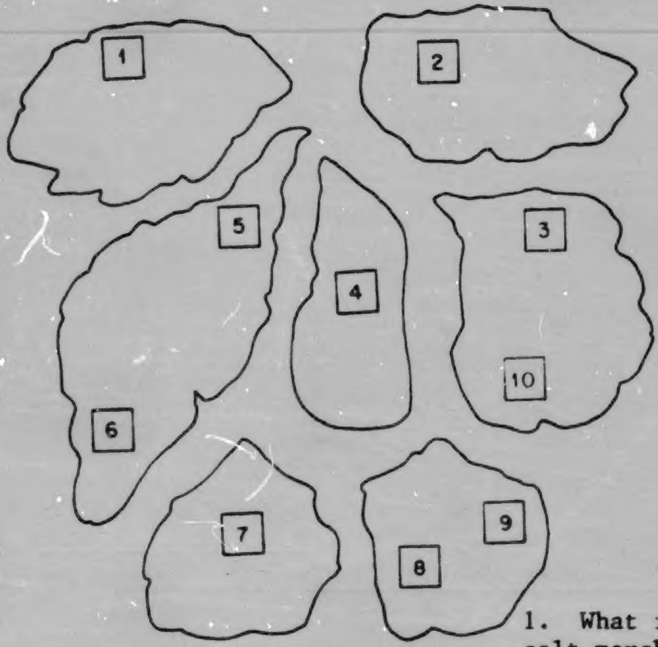
Activity Packet 5

Measuring the Productivity of Wetlands: 1

Salt marsh grass plants (including roots and aboveground parts) are harvested at the end of the growing season from an eastern saltmarsh. Ten one square meter samples were taken from different parts of the marsh. Each sample was dried and weighed. The weights below represent the gains in weight of plants during the growing period. They were obtained by comparing the final weights with average weights of similar samples taken at the start of the growing season.

Assuming that each gram of dry salt marsh grass holds 4.072 Calories we can estimate the productivity of this marsh in energy units by the expression:

$$\text{Calories/m}^2\text{/yr} = (\text{grams/m}^2\text{/yr})(4.076 \text{ Cals./g})$$



Siteof sampling	dry weight $g/m^2/yr$
1	4,433
2	3,232
3	2,605
4	4,189
5	2,083
6	3,164
7	2,694
8	4,395
9	3,329
10	2,296

TOTAL =

AVERAGE PRODUCTIVITY =

1. What is the average productivity of this eastern salt marsh in terms of Calories/m^2/yr?

2. Why are ten samples taken instead of one? How can you explain the variation among the 10 samples?

3. Why do you think it is necessary to sample the roots as well as the above ground plant parts?

4. In some New England salt marshes almost 90% of the production of Spartina (salt marsh grass) is below ground. Using the same average figure from the above exercise, how much productivity would be accounted for by the roots and rhizomes of these New England sample plots? How much by above ground parts?

Activity Packet 5

Measuring the Productivity of Wetlands: 2

PRODUCTIVITY FOR VARIOUS ECOSYSTEMS

Ecosystem Type	Productivity Range (g/m^2/yr)	Mean Productivity (g/m^2/yr)
tropical rain forest	1000-3500	2200
temperate forests	600-2500	1250
woodland and shrubland	250-1200	700
temperate grassland	200-1500	600
tundra and mountain	10- 400	140
desert and semidesert scrub	10- 250	90
extreme desert, rock, ice	0- 10	3
cultivated land	100-3500	650
swamp and marsh	800-3500	2000
lake and stream	100-1500	250
open ocean	2- 400	125
continental shelf waters	200- 600	360
algal beds and reefs	500-4000	2500
estuarine waters	200-3500	1500

Adapted from Whittaker, R. H. Communities and Ecosystems, 2nd edition. New York. Macmillan, 1975.

1. The chart above displays productivity values for several different ecosystem types. Which types are the most productive? Least productive?

2. On page 1 of Activity Packet #5 you determined the average productivity of an eastern salt marsh. How would this value compare with mean productivities of ecosystems in the chart above? Where in the "swamp and marsh" range does the eastern salt marsh fit?

3. Ecologists working at a Minnesota Cattail Marsh have determined the productivity of that ecosystem to be approximately 1600 $g/m^2/yr$. Assuming this is a typical value, what general conclusion can you make about the productivity of freshwater marshes compared with saltwater marshes?

4. There are about four Calories of energy per gram of plant matter. How many Calories are produced each year in one square meter of average swamp and marsh land? If it takes 2000 Calories of food per day to keep the average human in good health, how many square meters of agricultural land are needed to keep you fed for a year?

5. How many times more productive is wetland than open ocean? Temperate forest? Tundra?

Activity Packet 5

Measuring the Productivity of Wetlands: 3

IMPORTANCE OF VARIOUS ECOSYSTEMS IN PRODUCING FOOD FOR THE CONSUMERS OF THE WORLD

Area of Earth Covered			Amount of Food Produced	
million km^2	% of total	Ecosystem Type	billion tons per year	% of total
17.0		tropical rain forest	37.4	
7.5		tropical seasonal forest	12.0	
5.0		temperate evergreen forest	6.5	
7.0		temperate deciduous forest	8.4	
12.0		boreal forest (taiga)	9.6	
8.5		woodland and shrubland	6.0	
15.0		savanna	13.5	
9.0		temperate grassland	5.4	
8.0		tundra and alpine	1.1	
18.0		desert and semidesert scrub	1.6	
24.0		extreme desert, rock, ice	0.07	
14.0		cultivated land	9.1	
2.0		swamp and marsh	4.0	
2.0		lake and stream	0.5	
149.0		TOTAL CONTINENTAL	115.0	
332.0		open ocean	41.5	
0.4		upwelling zones	0.2	
26.6		continental shelf	9.6	
0.6		algal beds and reefs	1.6	
1.4		estuaries	2.1	
361.0		TOTAL MARINE	55.0	
510.0		FULL TOTAL FOR WORLD	170.0	

Adapted from Whittaker, R. H. Communities and Ecosystems, 2nd edition. New York, Macmillan, 1975.

1. Calculate the percent of full total area represented by each ecosystem type and record your answers in the chart. Do the same for percent of total amount of food produced.

2. What percent of the world is covered by marine ecosystems? Continental ecosystems? Wetland (swamp and marsh) ecosystems? In view of the small percentage area occupied by wetlands, why do you think their food production is of such great interest?

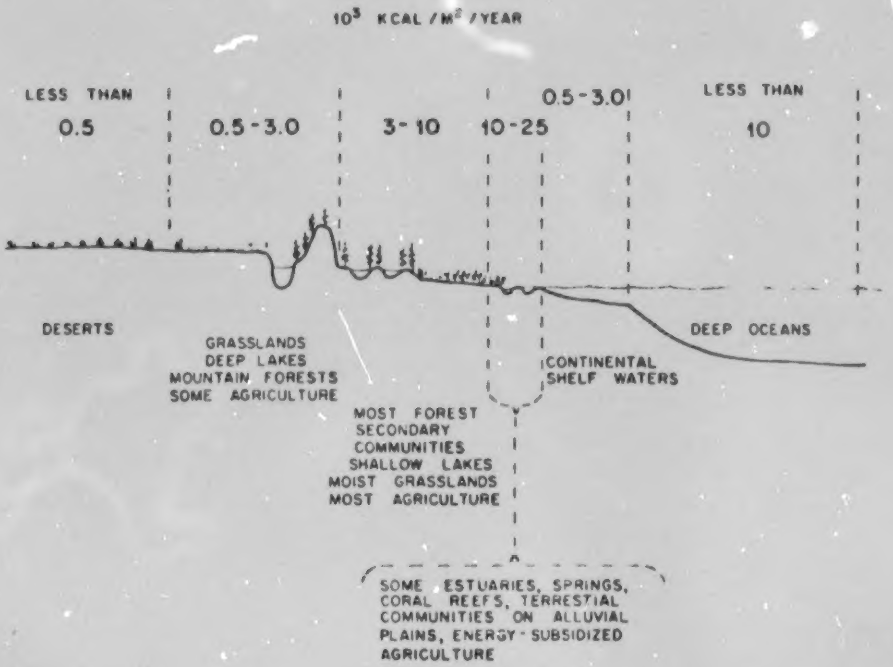
3. Compare the percentages in both columns for cultivated land, open ocean, and swamp/marsh. Which ecosystem type is the most efficient? Which ecosystem is probably the most important in terms of its total food production?

4. What amount of food would the open ocean produce each year if the ocean were as productive as wetlands? Compare your answer with the actual ocean production. Do the same calculation for cultivated lands. Do these figures give you a better answer for the last question in #2 above?

Activity Packet 5

Measuring the Productivity of Wetlands: 4

WORLD DISTRIBUTION OF PRIMARY PRODUCTION



10^3 KCAL / M^2 / YEAR
LESS THAN 0.5
0.5 - 3.0
3 - 10
10 - 25
0.5 - 3.0
LESS THAN 10
DESERTS
GRASSLANDS DEEP LAKES MOUNTAIN FORESTS SOME AGRICULTURE
MOST FOREST SECONDARY COMMUNITIES SHALLOW LAKES MOIST GRASSLANDS MOST AGRICULTURE
CONTINENTAL SHELF WATERS
DEEP OCEANS
SOME ESTUARIES, SPRINGS, CORAL REEFS, TERRESTIAL COMMUNITIES ON ALLUVIAL PLAINS, ENERGY - SUBSIDIZED AGRICULTURE

1. Where are the most productive areas of the Earth with relation to the land and water?

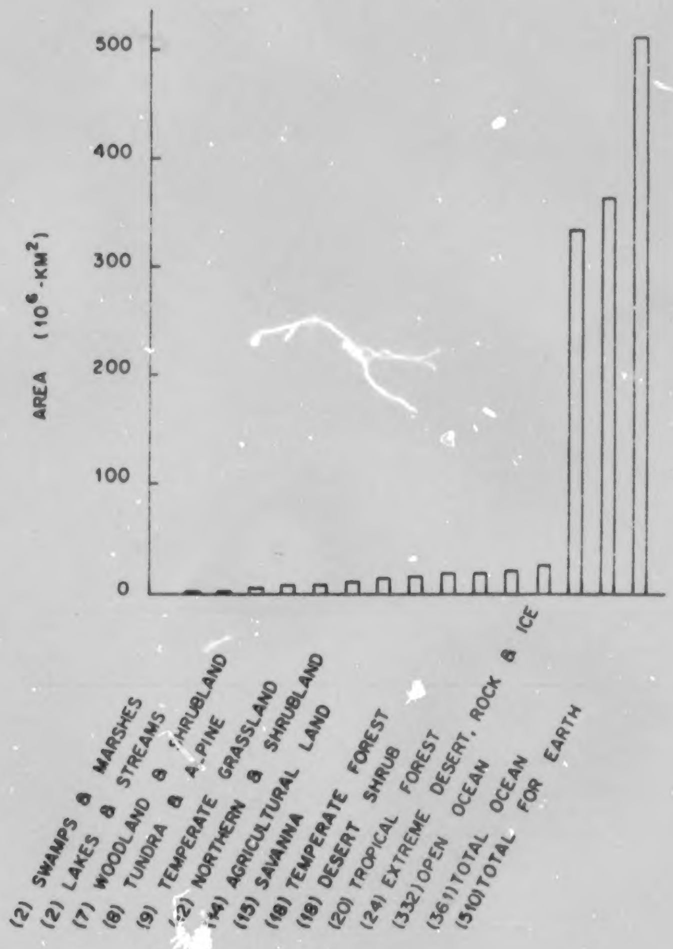
2. In which category does a bog fit?

3. How can farms or green houses on deserts or grasslands be made more productive than coral reefs?

Activity Packet 5

Measuring the Productivity of Wetlands: 5

AREA OF EARTH COVERED BY DIFFERENT ECOSYSTEMS



1. Which ecosystem has the greatest area?

2. Which ecosystem is the most productive? Least productive?

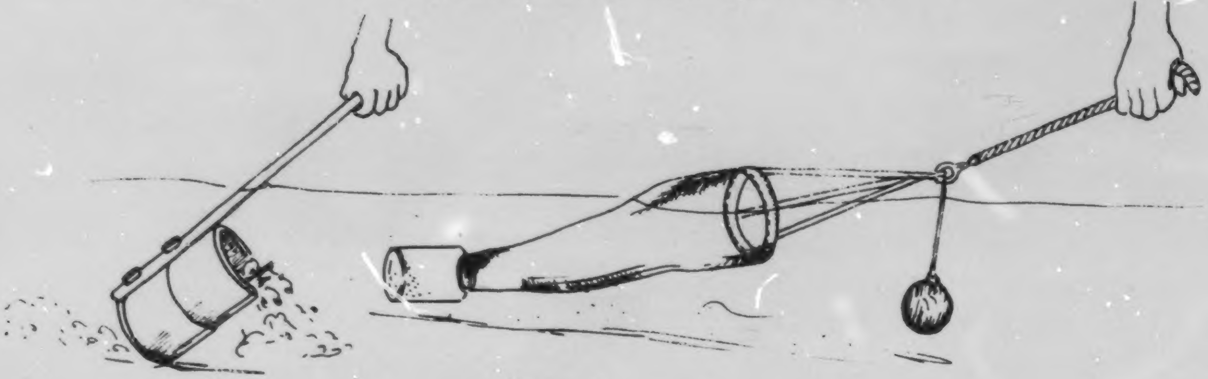
3. What percentage of the total biosphere produces more than 2000 KCal/m^2/year?

Chapter 6
Activity Sheets

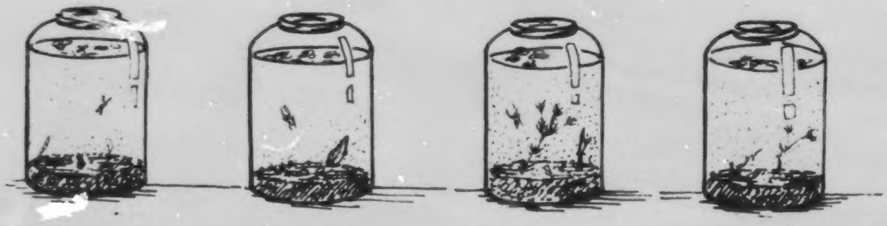
Activity Packet 6

Experiments in Wetlands Ecology

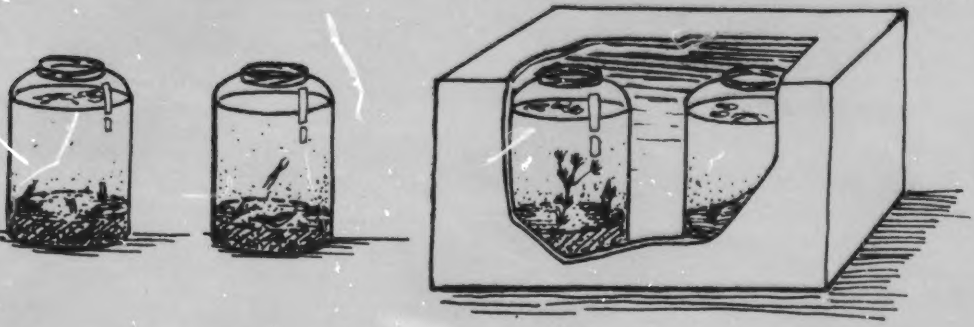
STEP 1 Take samples of water from several areas that have plants growing - such as the water's edge, the bottom and the open water, or the center of the wetland. By holding these samples up to the light, detect which one has the highest density of small organisms. Or you may choose to collect samples of small floating plants such as duckweed or algae.



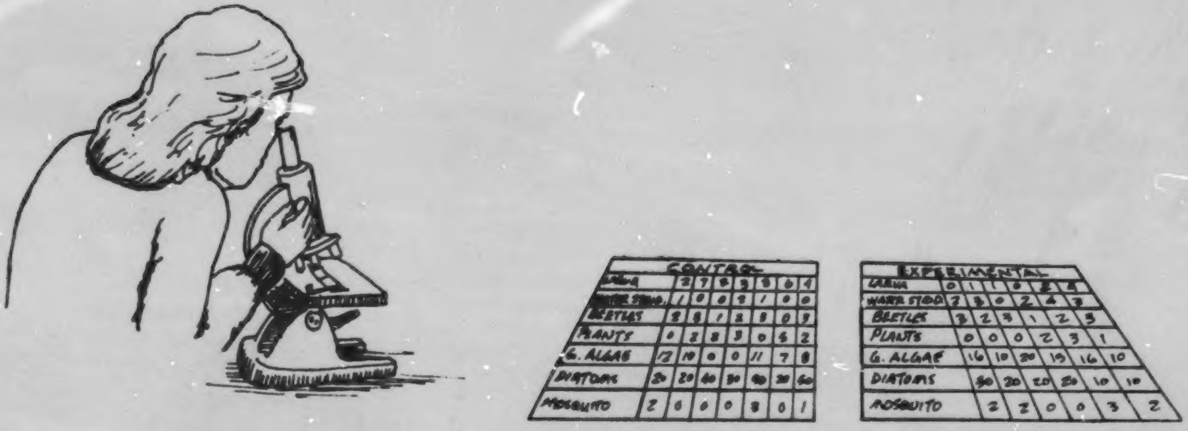
STEP 2 Discard the samples that don't have the highest density. Then take several more samples from the area with the highest microorganism density. Mix the samples by carefully pouring the water from one jar to another so each has a similar amount of organisms. This enables a comparison to be made between the samples later on in the activity.



STEP 3 Next, invent a method for varying one environmental factor - physical or chemical. One way is to keep some of the aquariums in a dark place or add a pollutant like detergent. Always keep a couple of aquariums under conditions as normal as possible and try to keep the others under the same conditions except for the factor you are varying. Here a student has hypothesized that reducing the length of daylight by half will reduce population size in the aquariums.



STEP 4 Beginning on the first day, examine the microorganisms every two or three days. Put a drop of water on a slide and view it under a microscope if you can't see the microorganisms with your naked eye. Record how the populations of organisms in the controls and the experimental jars change with time. Continue the study for as long as changes in the biological community occur. Here is where scientific research seems to be most challenging to students. Many students become bored with the tedious work required in Step 4. Serious research scientists have the self discipline to stick to these step four type tasks.



CONTROL							
LARVA	2	7	8	3	3	6	4
WATER STRID.	1	0	0	3	1	0	0
BEETLES	3	3	1	2	3	0	3
PLANTS	0	2	3	3	0	6	2
G. ALGAE	17	10	0	0	11	7	8
DIATOMS	20	20	40	30	30	20	60
MOSQUITO	2	0	0	0	3	0	1

EXPERIMENTAL						
LARVA	0	1	1	0	2	4
WATER STOD	2	3	0	2	6	3
BEETLES	3	2	3	1	2	3
PLANTS	0	0	0	2	3	1
G. ALGAE	16	10	20	19	16	10
DIATOMS	30	20	20	20	10	10
MOSQUITO	2	2	0	0	3	2

Keeping Floods under Control

Chapter 7
Activity Sheets

Activity Packet 7

Data Sheet 1: Horizontal Spread of Floods

Year	Day	Watertown	Cambridge	Boston
1890	1	2.0 ft.*	3.0 ft.	3.6 ft.
	2	3.0 ft.	4.2 ft.	4.1 ft.
	3	3.0 ft.	4.3 ft.	4.8 ft.
	4	2.0 ft.	4.5 ft.	5.2 ft.
1930	1	2.2 ft.	2.8 ft.	3.1 ft.
	2	2.6 ft.	3.9 ft.	4.4 ft.
	3	3.0 ft.	4.8 ft.	5.9 ft.
	4	3.0 ft.	5.7 ft.	7.1 ft.
1960	1	2.4 ft.	2.7 ft.	3.4 ft.
	2	2.8 ft.	3.0 ft.	5.9 ft.
	3	3.1 ft.	3.0 ft.	8.6 ft.
	4	3.1 ft.	3.0 ft.	13.5 ft.

*Distance from riverbank on that day

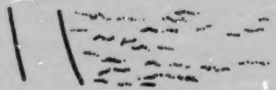
Activity Packet 7

Data Sheet 2: Maximum Height of Water During Flood

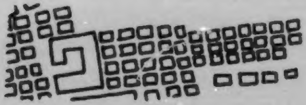
Year	Watertown	Cambridge	Boston
1890	4.1 ft.	4.0 ft.	4.2 ft.
1930	4.5 ft.	6.9 ft.	7.3 ft.
1960	4.6 ft.	4.4 ft.	12.8 ft.

Activity Packet 7

Legend

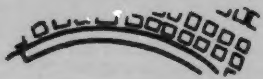


= freshwater marsh



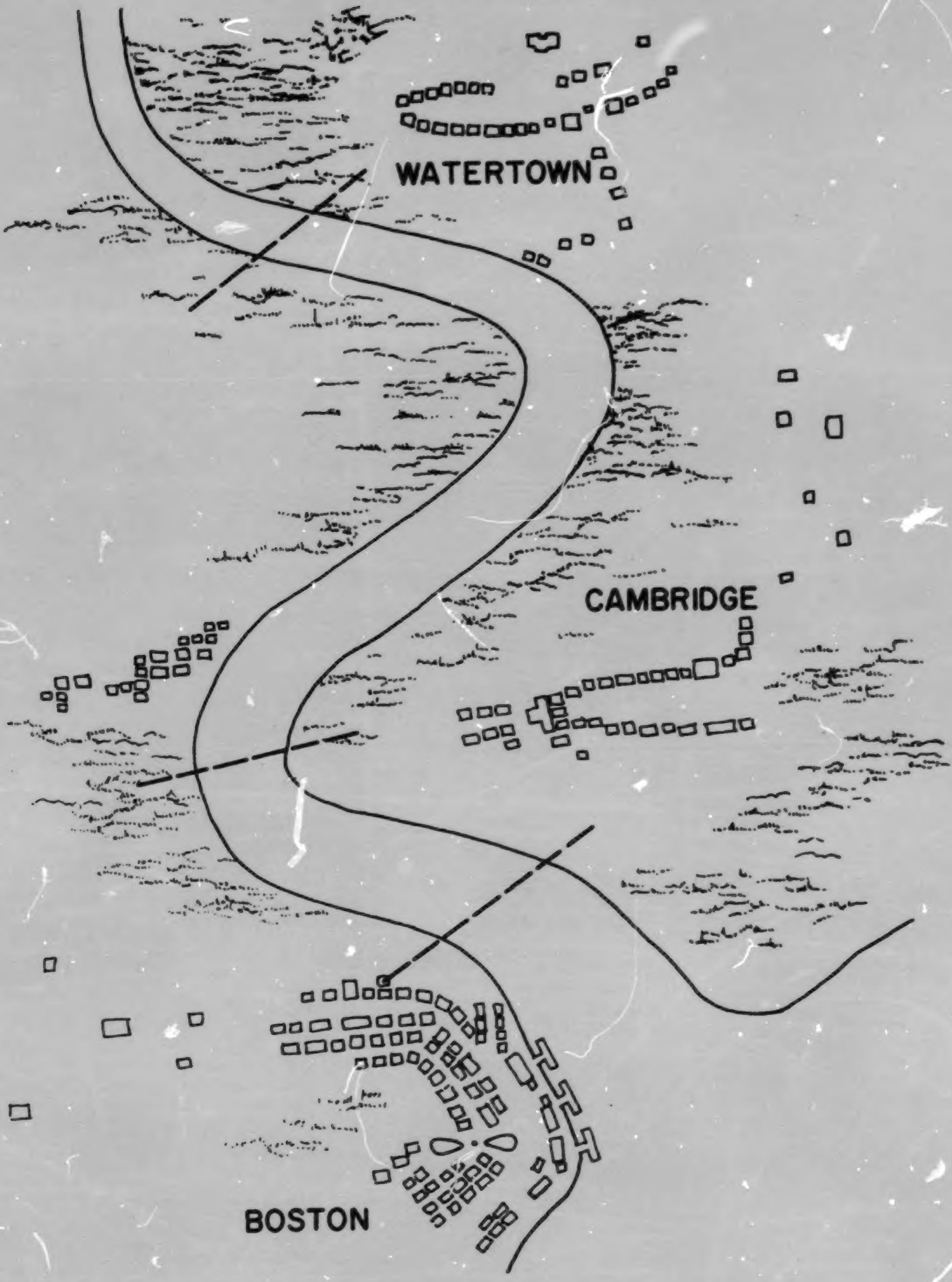
= developed area: homes, buildings, parking lots, paved areas, etc.

----- = area in which flood measurements were made

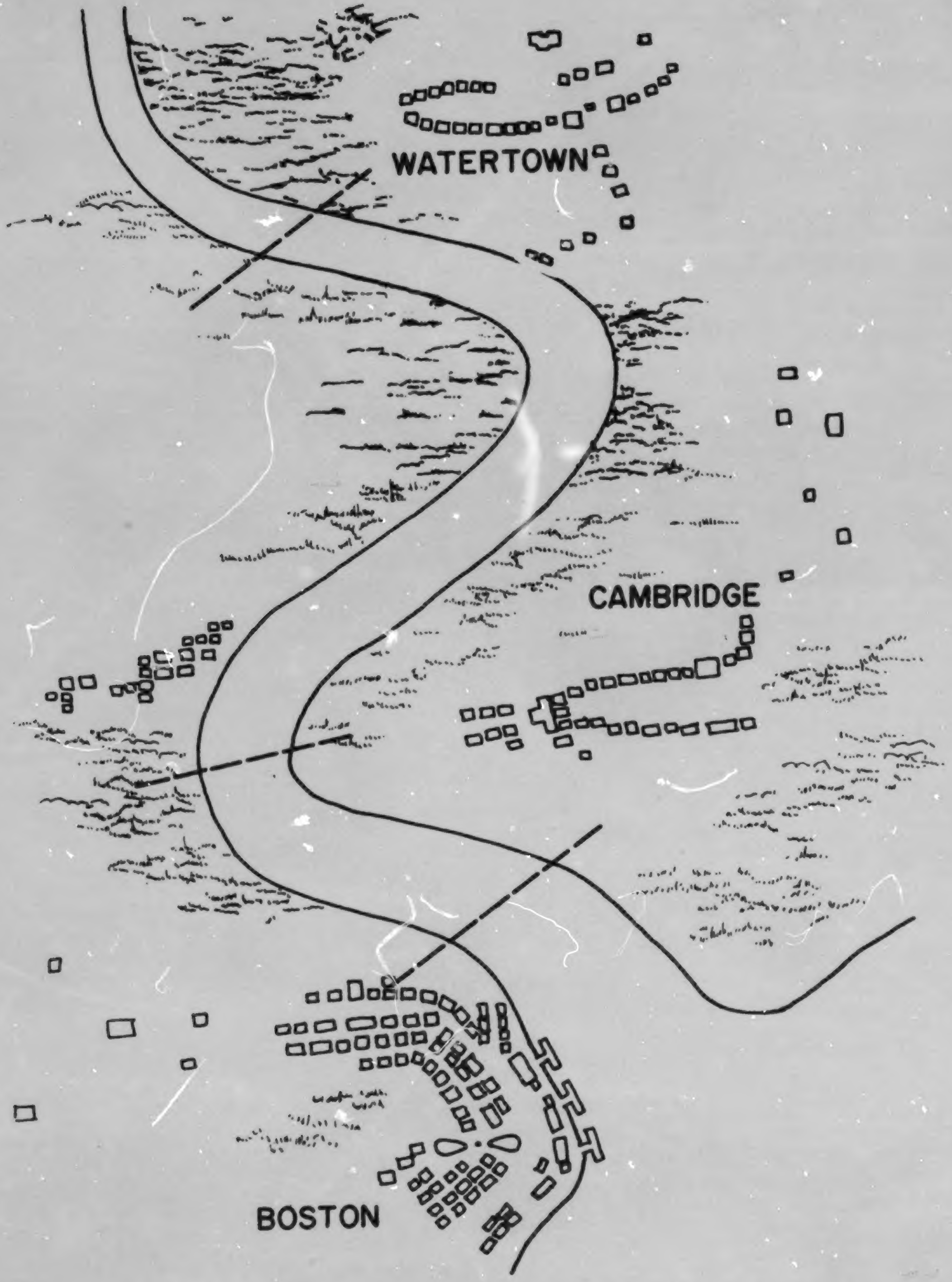


= dikes built near Cambridge in 1950

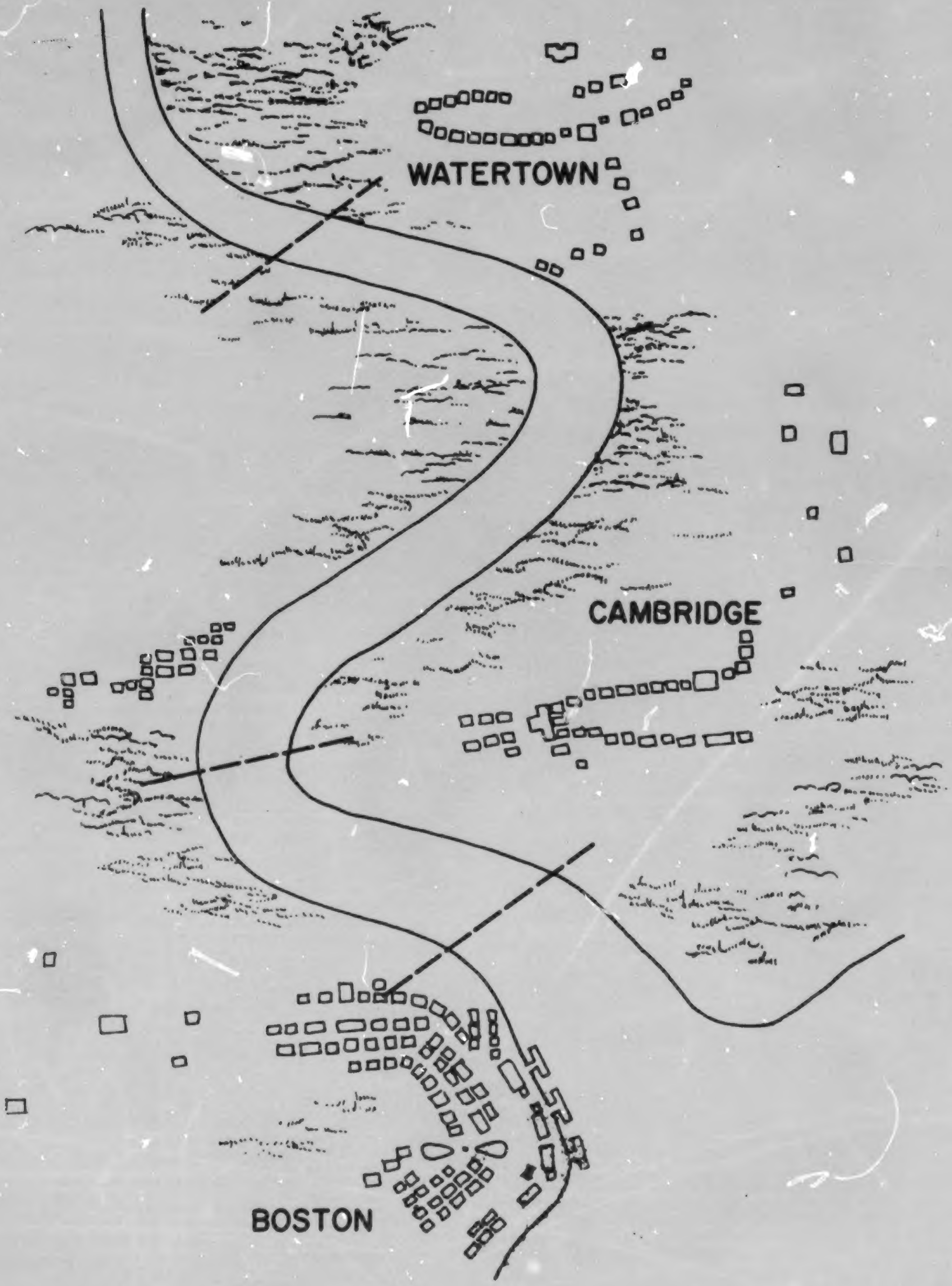
To show horizontal flooding on maps, let 1 cm represent a distance of 4 feet. This is not the proper scale, but will allow you to compare flooding from one year to the next.


WATERTOWN
CAMBRIDGE
BOSTON

1890: DAY 4

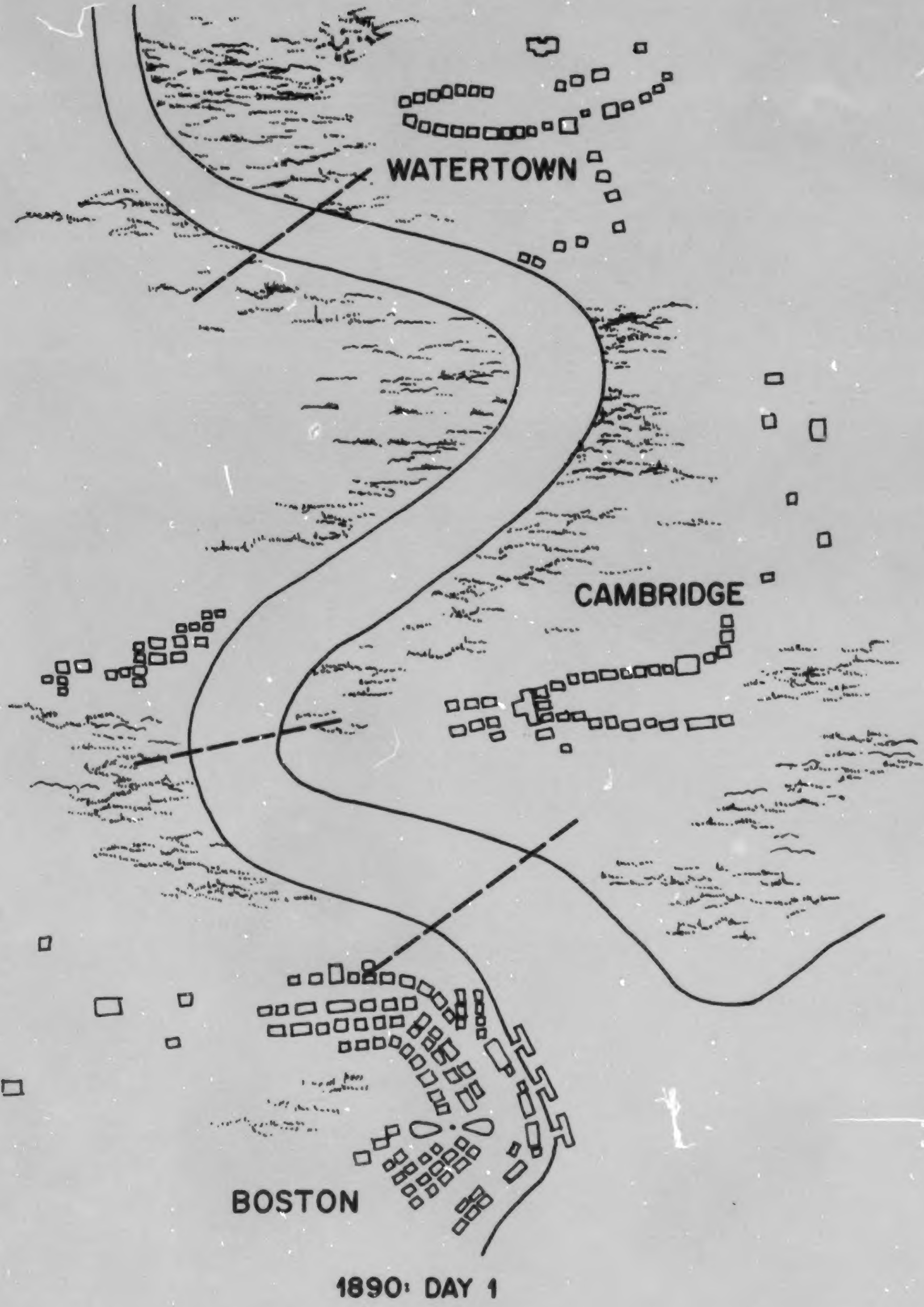

WATERTOWN
CAMBRIDGE
BOSTON

1890: DAY 3

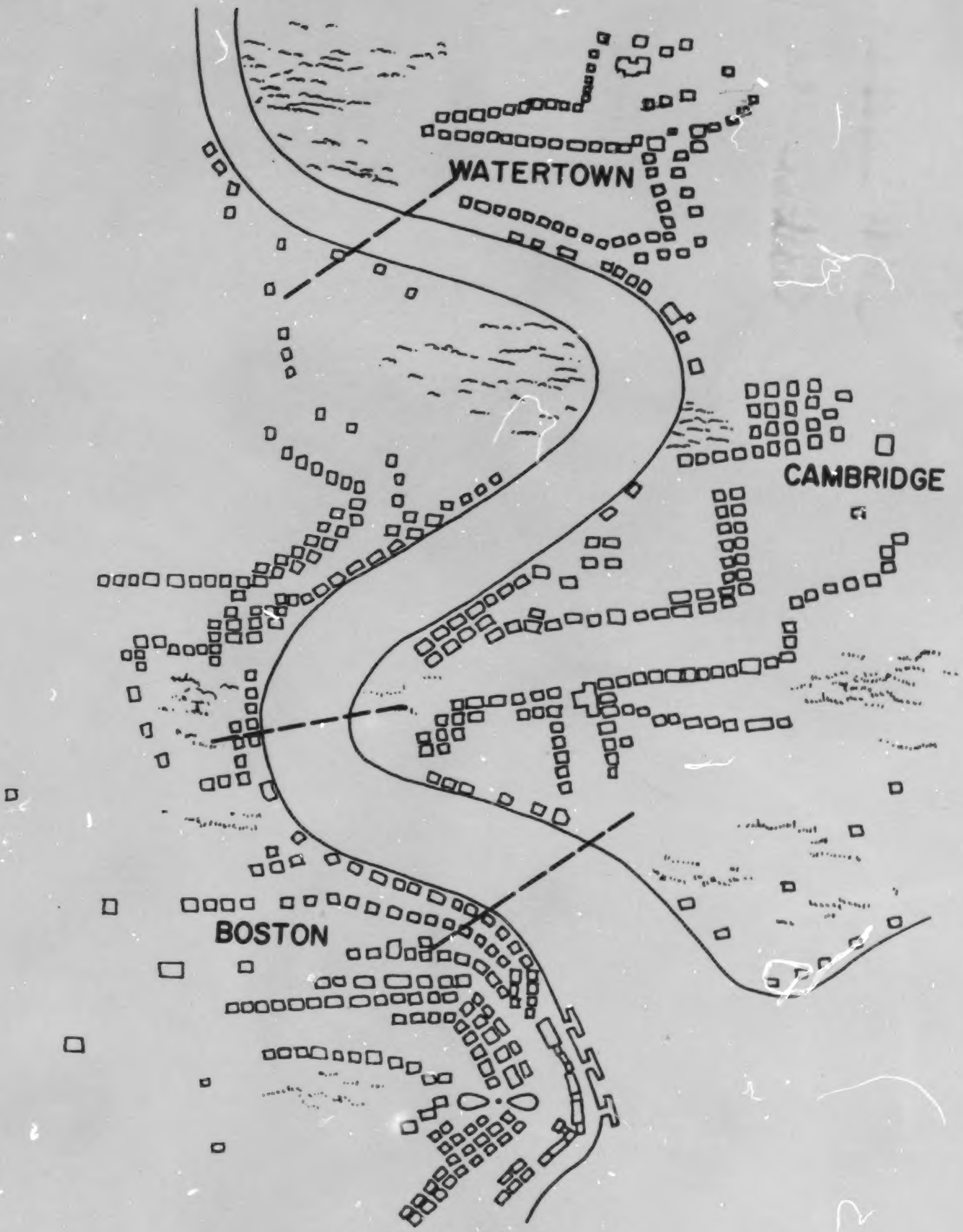

WATERTOWN
CAMBRIDGE
BOSTON

1890: DAY 2

7-6

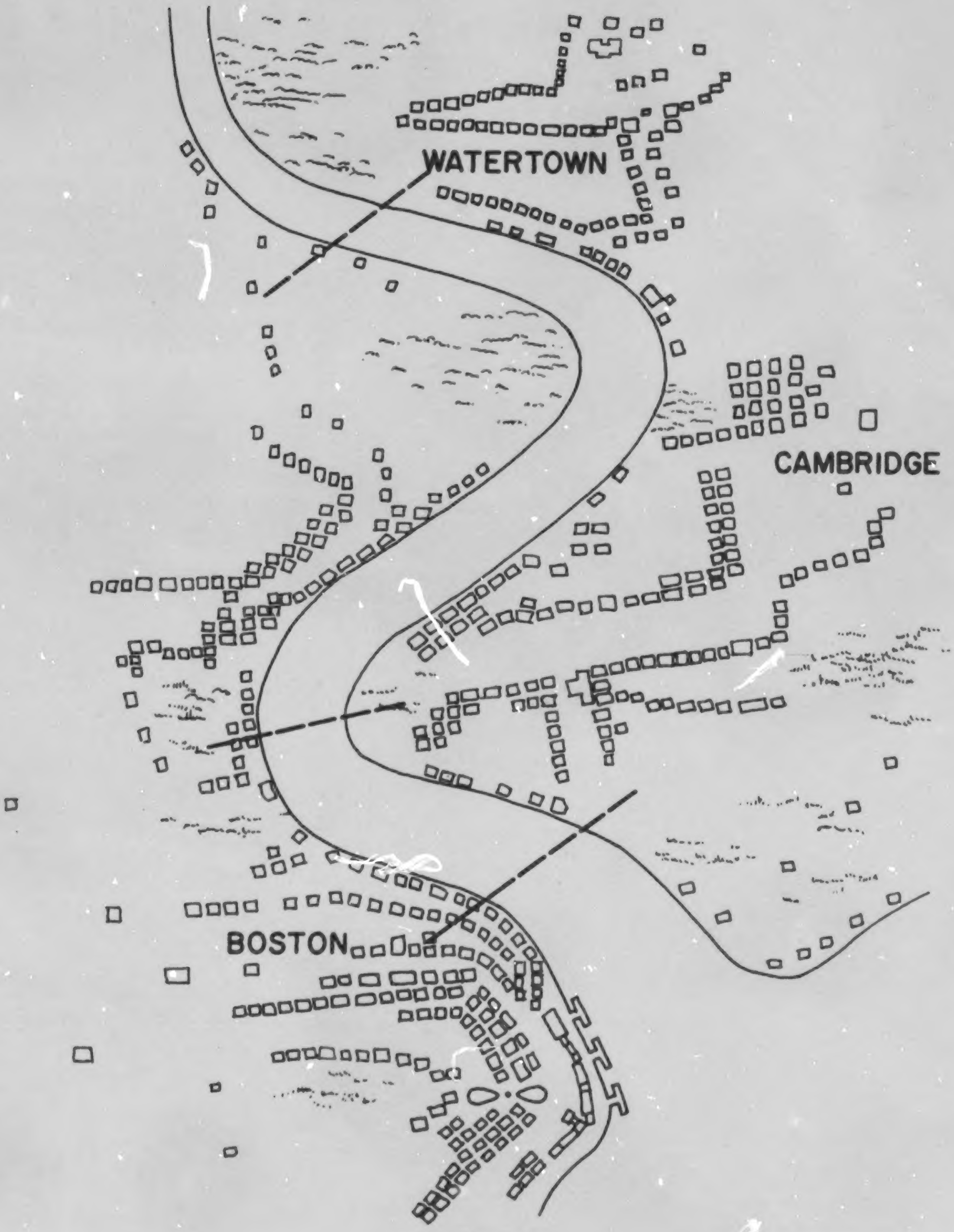

WATERTOWN
CAMBRIDGE
BOSTON

1890: DAY 1


WATERTOWN
CAMBRIDGE
BOSTON

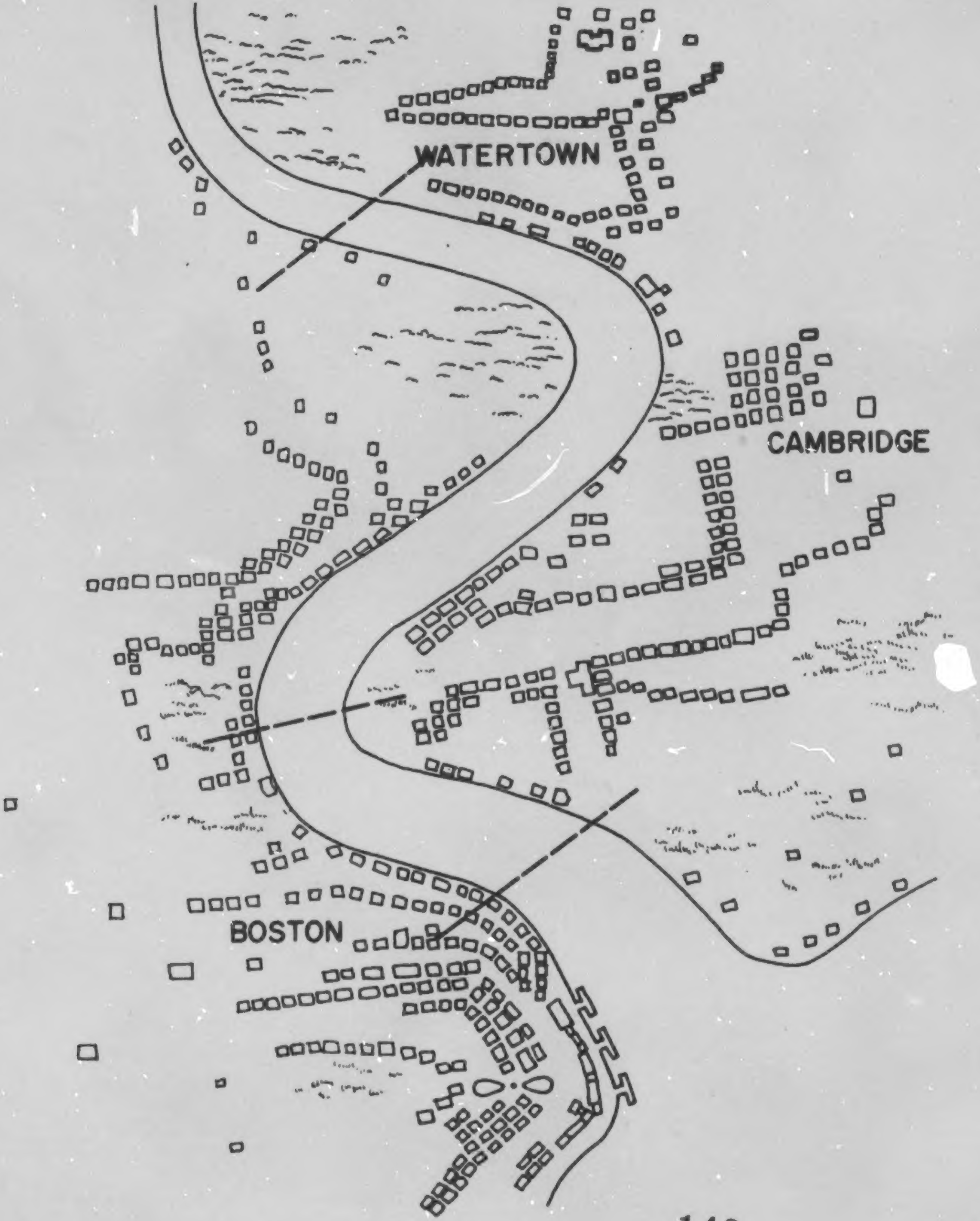
1930: DAY 4

147


WATERTOWN
CAMBRIDGE
BOSTON

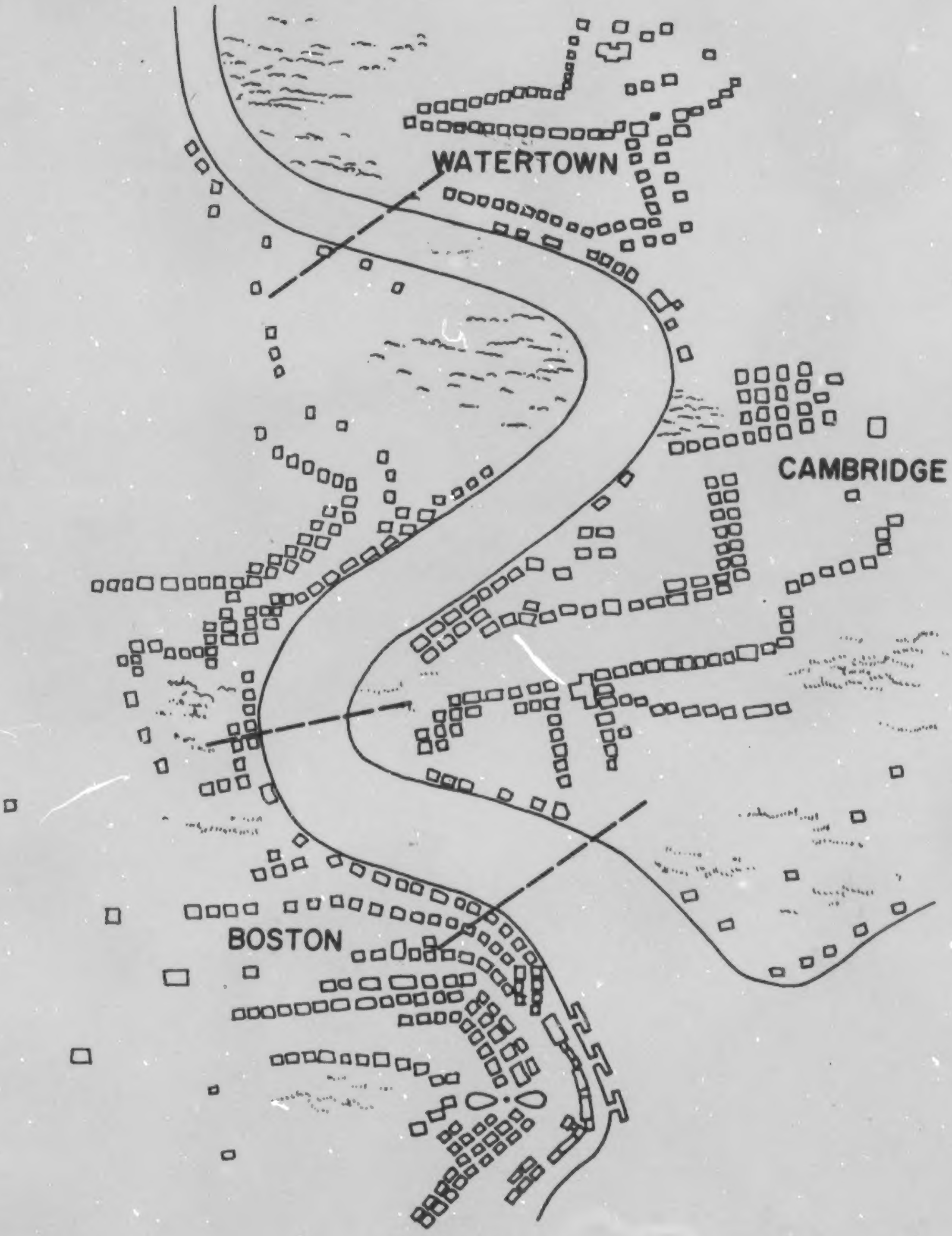
1930: DAY 3

7-9


WATERTOWN
CAMBRIDGE
BOSTON

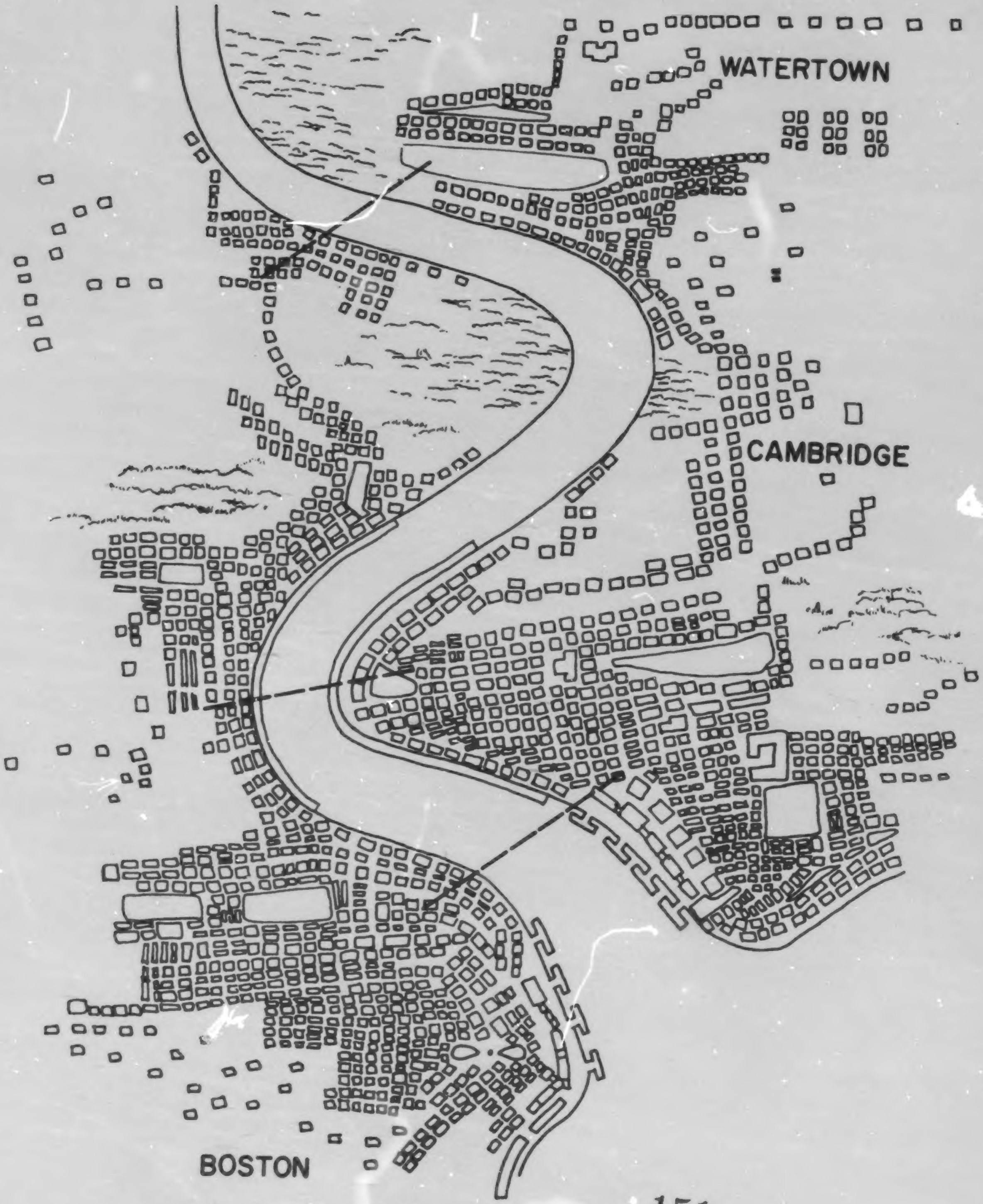
1930: DAY 2

7-10


WATERTOWN
CAMBRIDGE
BOSTON

1930: DAY 1

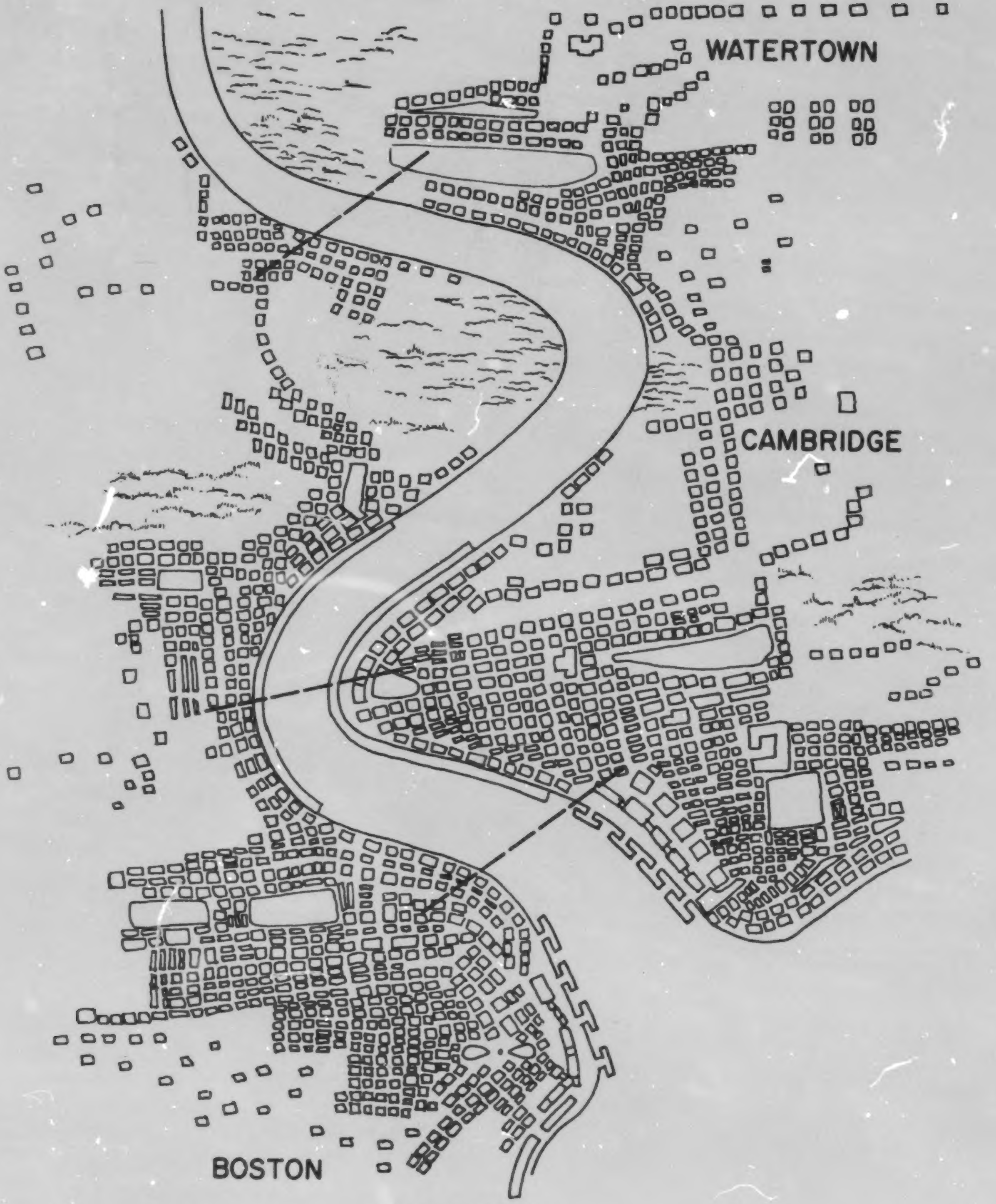
7-11 150


WATERTOWN
CAMBRIDGE
BOSTON

1960: DAY 4

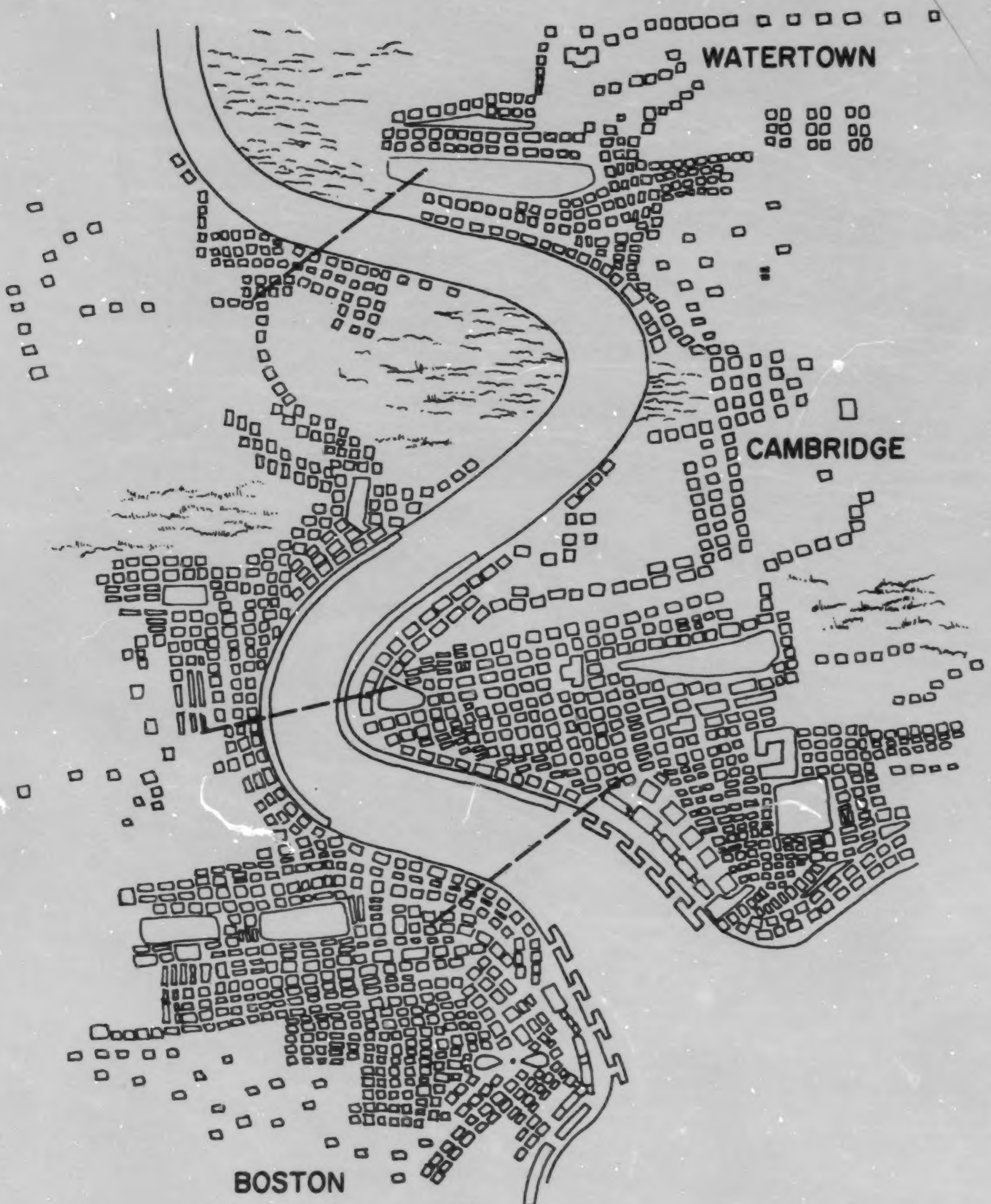
151

7-12


WATERTOWN
CAMBRIDGE
BOSTON

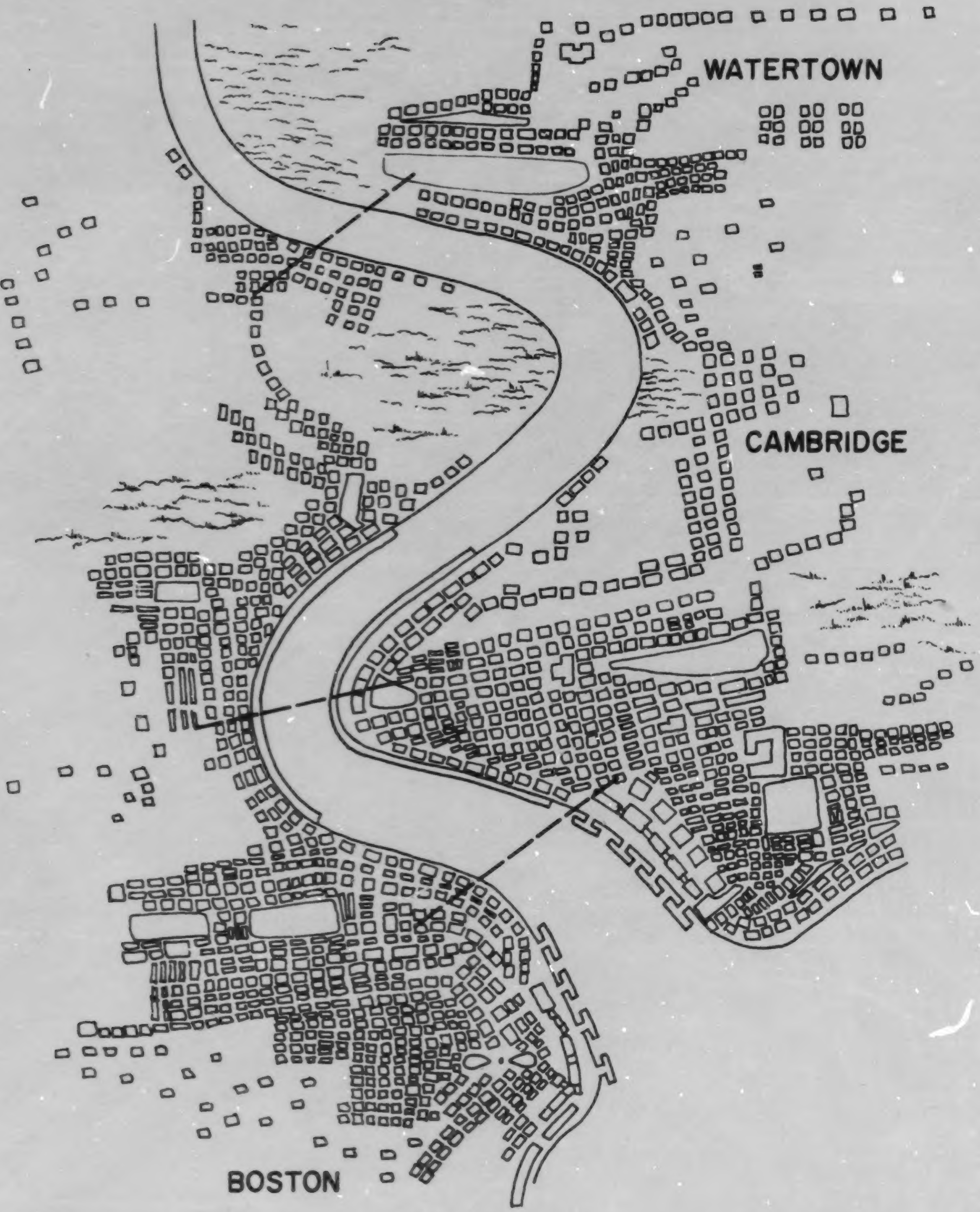
1960: DAY 3

7-13


WATERTOWN
CAMBRIDGE
BOSTON

1960: DAY 2

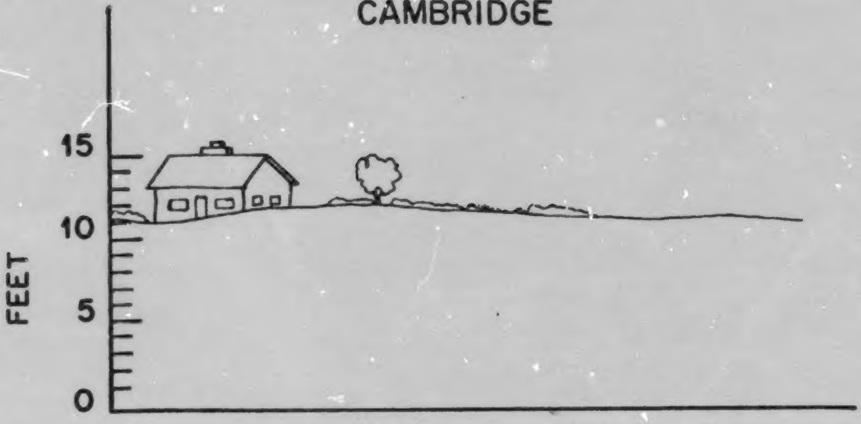
7-14


WATERTOWN
CAMBRIDGE
BOSTON

1960: DAY 1

7-15

CAMBRIDGE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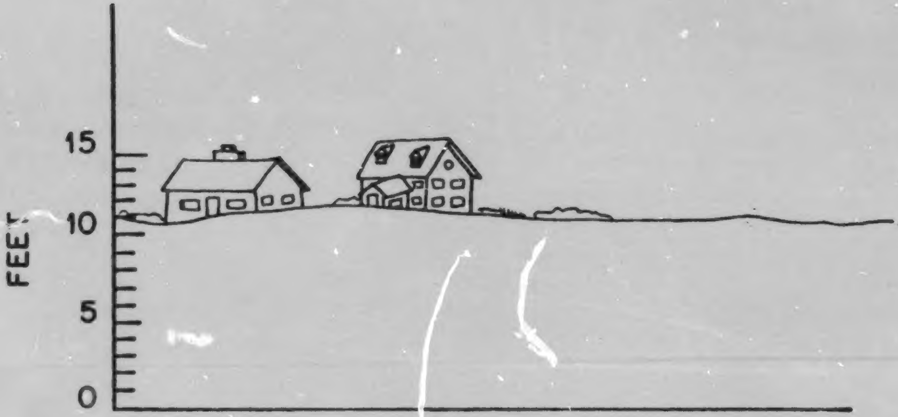
1890: HIGH POINT OF FLOOD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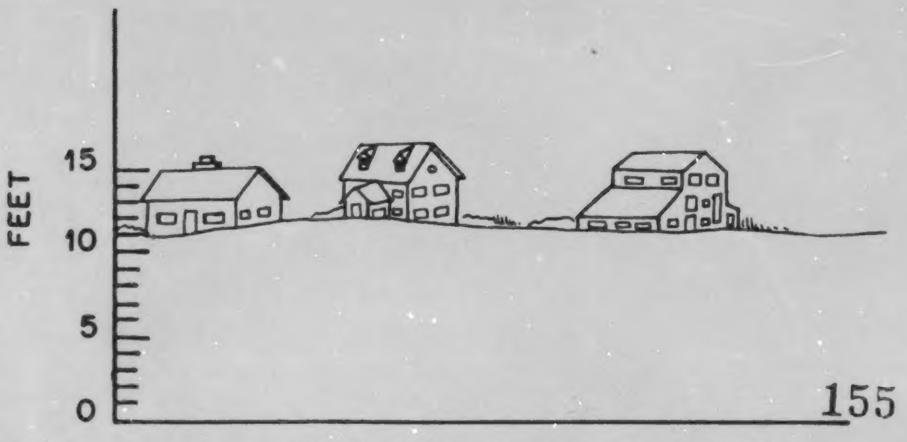
1930: HIGH POINT OF FLOOD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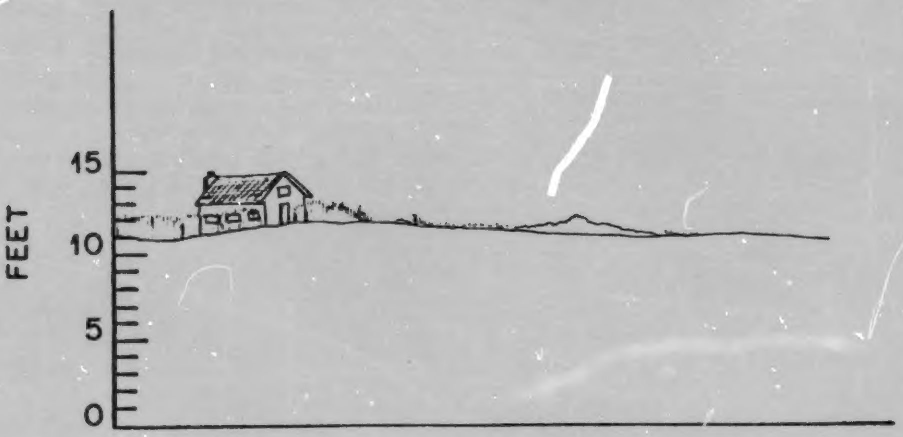
1960: HIGH POINT OF FLOOD

7-16

BOSTON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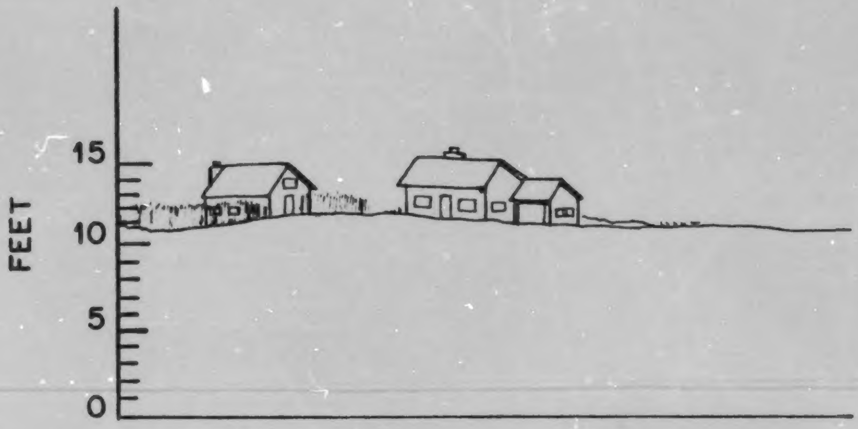
1890: HIGH POINT OF FLOOD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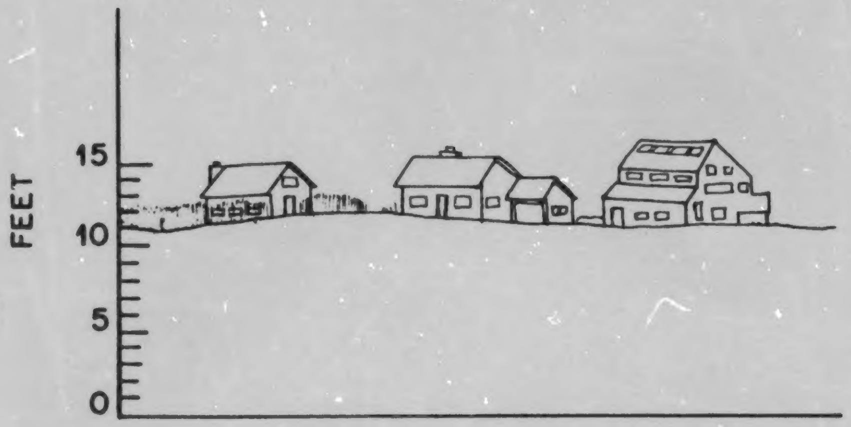
1930: HIGH POINT OF FLOOD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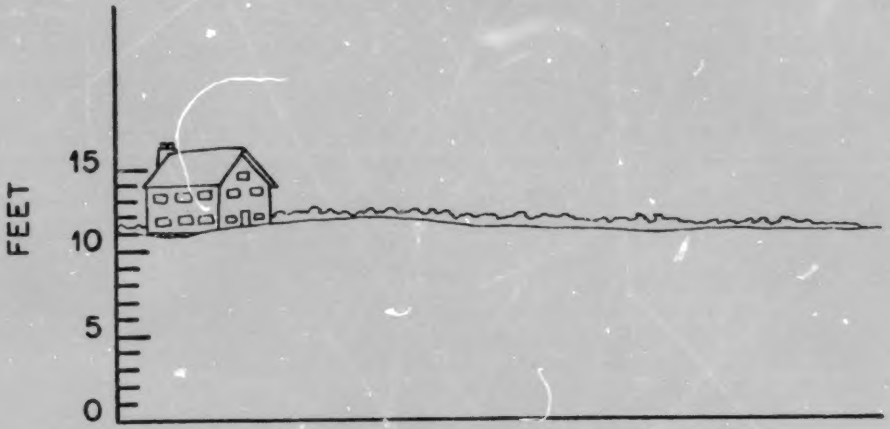
1960: HIGH POINT OF FLOOD

7-17

WATERTOWN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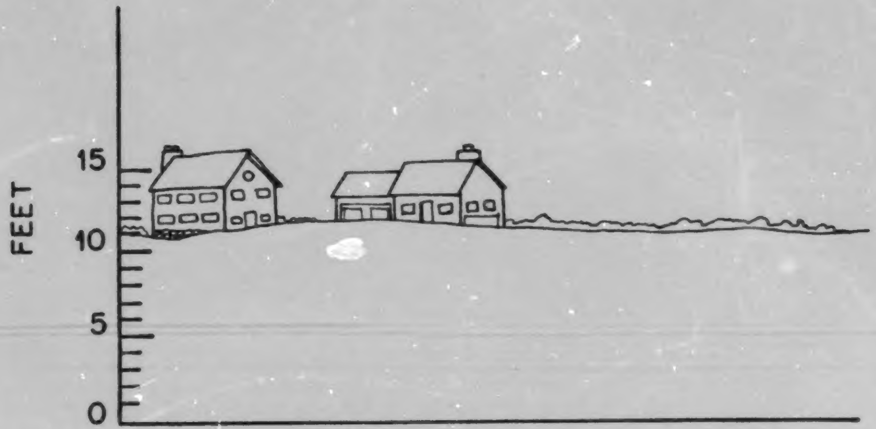
1890: HIGH POINT OF FLOOD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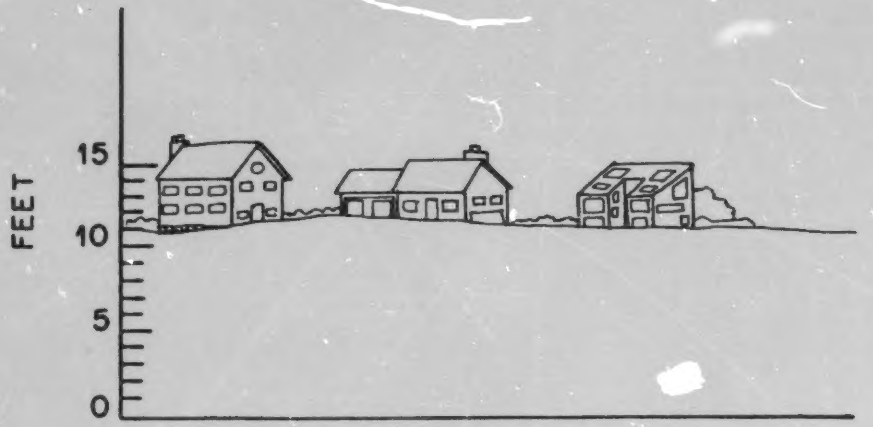
1930: HIGH POINT OF FLOOD


FEET
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1960: HIGH POINT OF FLOOD

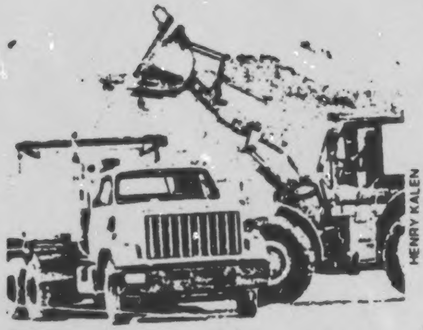
7-18

No Activity Sheets For This Chapter

Chapter 9
Activity Sheets

LEVICK · WINNIPEG TRIBUNE

Reese, Peter Tkachuk and Dennis Kiene celebrating; and (right) new Borger asphalt plant: waiting for official thanks



HENRY KALEN

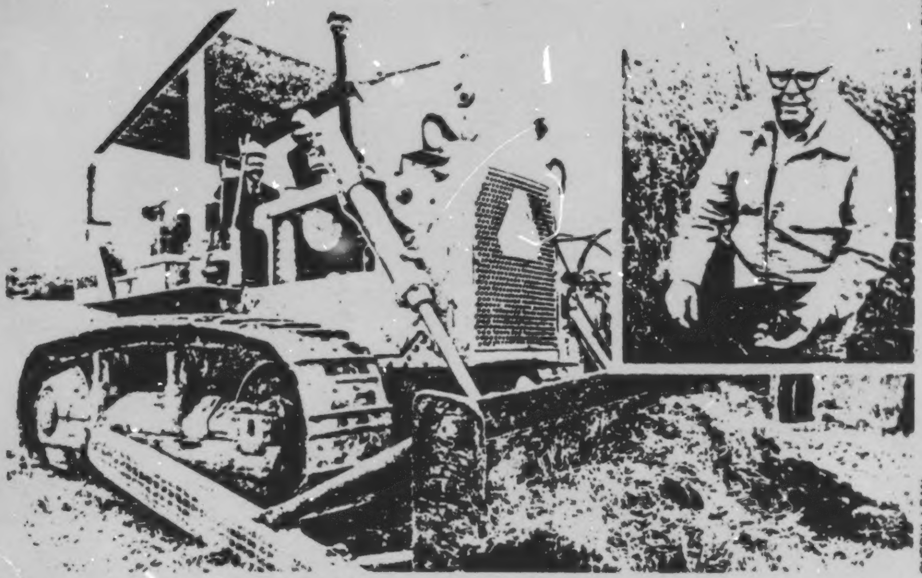
Nova Scotia

Progress and a slap in the face

"When we came here in 1968, this field was so waterlogged you couldn't walk across it." Nova Scotia farmer Robyn Warren is speaking and waving his arm over 20 acres of newly sprouting wheat at the edge of the Annapolis River on land that used to be flooded each time the tide swept in from the Bay of Fundy. Through hard work and an innovative drainage system, 51-year-old Warren has reclaimed 300 acres and turned it into some of the most productive land in the province. But, 16 km downstream, Premier John Buchanan late last month turned the sod on a tidal-power project which threatens to undo all Warren's efforts and those of other farmers along the riverbanks.

The sod-turning was a historic event: it is the first tidal-power project in North America and, while it's not *quite* the real thing (it won't be harnessing the Bay of Fundy tides at their highest point), officials predict that the $46-million Annapolis River pilot scheme could bring construction of a major project on the bay itself closer by several years. The short-term objective is to test a 250-ton Straflo turbine which should produce 50 million kilowatt-hours of electricity annually (about two per cent of Nova Scotia's needs). The technology isn't new—about 70 Straflo turbines are in use in Europe—but the size is: this turbine is twice as large as any of its type now in operation.

Nova Scotian Acadians were the first



CHERYL LEAN

CHERYL LEAN

Buchanan turning sod; and (inset) Warren: sucking salt and killing crops

to reclaim Annapolis River marshlands, with a system of sluices and dikes built 300 years ago. Those eroded over time and were replaced in the early 1960s by a causeway across the mouth of the river. The turbine will be installed in the existing causeway but the river level will have to be raised by one metre to make it work. Warren's land sits like a saucer surrounded on two sides by the meandering Annapolis, only slightly above mean sea level and drained by underground tiles. When the water level is raised the tile system, which now takes water out of the land, will back up, sucking salt water into the soil and killing the crops.

Ironically, it's precisely because Warren is an innovator that he now stands to lose the most. He is one of the few farmers on the marshlands to use an underground tile system and is the only one to grow anything more sophisticated than hay. He expects to harvest 500 tons of grain and beans this season.

Martec Limited, the Halifax consulting firm that carried out an environmental-impact study for the Tidal Power Corporation (a provincial Crown corporation), said Warren's land is a model for the agricultural potential of all the marshlands in the area. It also said that, depending on how high the water level is allowed to go, significant damage to land would occur unless unspecified "remedial measures" were taken. Tim Hennigar, past president of the Annapolis County Federation of Agriculture, predicts as many as 200 acres could be lost and says his group is prepared to work with government to minimize the damage.

TPC Vice-President George Baker says whatever measures are necessary won't be determined until at least next year (the tidal-power project won't come on stream until 1983). But Baker says Warren has nothing to worry about because the Tidal Power Corporation is committed to not destroying farmland. Warren, for his part, is understandably wary of dealing with government agencies because of a dust-up he started in the late '60s after the government sprayed his land with 2 4 5-T. Dalhousie University biologist David Patriquin, who agrees that Warren has good cause to worry, says the farmer is still considered a "troublemaker" in government circles.

Coline Campbell, federal MP for the area, South West Nova, says Warren has a "legitimate concern" and should be putting a price on the land now so he can evaluate possible future losses. Warren feels his hands are tied because he's not prepared to see "lawsuits flying again." He emphasizes that he's not against the pilot project, which will pump an estimated $25 million into the local economy over three years and could be the forerunner to the world's first major tidal-power project on the Bay of Fundy. It's just that the shot in the arm for Nova Scotia may turn out to be a slap in the face for him.

Sue Calhoun

Snack time for the gypsies

Since René Lévesque took over Quebec, anglophones aren't the only ones to decamp for greener pastures. Among the emigrants are gypsy moths, whose mild-mannered but voracious caterpillars enjoy nothing so much as a blue-plate special of oak, birch or willow leaves. The larvae have been doing in shade trees in Quebec since 1925 and now they are showing up in other parts of Canada, gypsy eggs having been inadvertent stowaways in vehicles outbound from Quebec. This summer, alarmed at the possibilities, Agriculture Canada is setting out 10,000 moth traps in major cities across the land—mainly to see just how extensive the migrations have been.

Like so many other North American pests to surface over the years, the gypsy moth eggs were deliberately imported from France, in 1869, by the well-meaning naturalist Leopold Trourelot, who tried (and failed) to crossbreed them with native silkworms. Alas, several promptly escaped from Trourelot's laboratory in Medford, Mass., and dinner was served. Within half a century, the gypsy larvae were patronizing the finest shade trees of Quebec. By 1978, they were dining out in Vancouver. "We found a few males and about 50 egg masses," recalls Ottawa-based Agriculture Canada entomologist Al Schmidt. "Unfortunately they were in the area of the Greenpeace Foundation headquarters. We had quite a battle with them before we were able to spray. Hopefully we got most of them." Schmidt traced the Vancouver gypsies to a single Quebec family which had unknowingly taken them west clinging to a canoe and a rowboat.

AgriCan's red-colored A-frame traps, about 25 cm long and 12 cm high, contain the synthetic female hormone pheromone, with a scent so powerful it can attract male gypsy moths from several kilometres away. If significant numbers are found, AgriCan cancels their reservations with a toxic spray called carbaryl. "The caterpillars are black and about two inches long," says Schmidt. "They have pretty, but sharp, irritating spikes topped with blue and red knobs. They're not so attractive, though, when you see hordes of them stripping trees." Guess who's coming to dinner?

Peter Carlyle-Gordge

Dennis Lidgett setting trap: the great trek west, clinging to a canoe and a rowboat

HENRY KALEN

Vegetation Patterns and Processes in New England Salt Marshes

William A. Niering and R. Scott Warren

Salt marshes are grass-dominated tidal wetlands fringing the land-water interface of many temperate regions. They are an integral part of the larger tidal marsh-estuarine ecosystems, which are among the most biologically productive in the world. There is considerable evidence that fin and shell fisheries depend on the biological activities occurring on these tidal wetlands (Cruz 1973, Odum and Skjei 1974, Teal 1962). Tidal marshes play an important role in nutrient cycling within estuaries (Welsh 1980, Woodwell and Whitney 1977). They can also serve in pollution filtration, sediment accretion, and erosion control (Grant and Patrick 1970, Sanders and Ellis 1961, Windom 1977). Their distinctive flora, as well as their rich spectrum of waterfowl and other wildlife, make them attractive to sportsmen and naturalists. Their economic value has been estimated at more than $197,600 per hectare ($80,000 per acre, Gosselink et al. 1974).

Chapman (1960) has described nine different geographical coastal marsh regions throughout the world. The New England type marshes, extending from Maine to New Jersey, have developed a distinctive layer of fibrous peat along resistant rocky shores, where silt has been somewhat limited compared to other marsh areas. In New England, they tend to occur as relatively small individual systems in drowned valleys or behind barrier beaches.

This paper deals primarily with the origin, vegetation patterns, and productivity of southern New England marshes and the role of man's impact on them, based mostly on research along the Connecticut shoreline of Long Island Sound.

MARSH DEVELOPMENT

The tidal marshes of New England are relatively recent land forms. They have developed as a result of the interaction of tidal marsh vegetation and a gradually rising sea level (Bloom and Stuiver 1963, Redfield 1965, 1972). Between 3000 and 4000 years ago, the relatively rapid post-glacial sea level rise of 2.3 mm/yr decreased to about 1 mm/yr. This allowed rates of sediment accretion within stands of intertidal saltwater cordgrass (*Spartina alterniflora*)—hereafter referred to as "alterniflora"—to keep pace with the rise in sea level. Thus, instead of being submerged and lost, such stands were able to perpetuate themselves, moving outward over tidal flats and landward over gradually flooding upland or freshwater wetlands (Figure 1). With sufficient sedimentation in the landward portions of the newly developing marshes, the elevation was raised just above mean high water. This allowed the establishment of less flood-tolerant species, especially salt-meadow cordgrass (*Spartina patens*)—hereafter referred to as "patens." This process of seaward and landward development resulted in the low and high marsh vegetation pattern that now exists. First documented by Redfield (1965) on Cape Cod, this model for marsh development has been reported in New Hampshire (Keene 1971), Delaware (Elliott 1972), and Connecticut (Niering et al. 1977).

Radiocarbon dating of peat samples from various depths allows the establishment of the relationship between age and depth submergence. Keene (1971) demonstrated that such a relationship is reasonably consistent for a number of New England marshes. Peat has accumulated vertically at about 1 m/1000 years for the last 3000 years. Based on Pb 210 studies, McCaffrey (1977) has shown that, in recent times, depth/age curves are nearly congruent with sea level/age curves. In addition, his data dem-

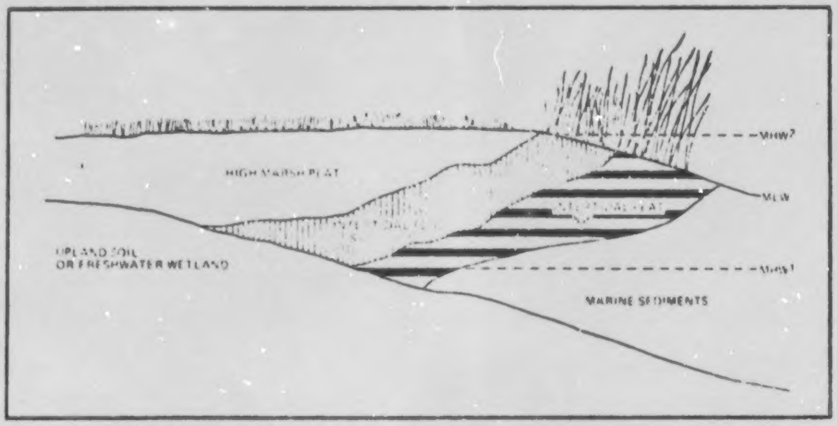


Figure 1. Bisect showing marsh development oceanward with intertidal *Spartina alterniflora* tall (Sat) and intermediate (Sai) peat being replaced by high marsh peat. Key: MHW^1 = mean high water when marsh development began; MHW^2 = mean high water at present; MLW = mean low water at present. (After Redfield 1965)

Niering is director of the Connecticut Arboretum and Katharine Blunt Professor of Botany; Warren is Associate Professor of Botany—both are at Connecticut College, New London, CT 06320. © 1980 American Institute of Biological Sciences. All rights reserved.

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onstrate that the increase in marsh surface elevation has paralleled the relatively recent 3 mm/yr rate in sea level rise (Hicks and Crosby 1974).

Nonetheless, local dynamics can result in accretion rates ranging from less than 2.0 to 6.6 mm/yr (Flessa et al. 1977, Harrison and Bloom 1977, Niering et al. 1977), which can be reflected in the age of uniformly deep peat samples. The variability in accretion combines with various rates of peat compaction to keep the marsh surface at or just above mean high water (McCaffrey 1977). It can also result in very different ages for uniformly deep peat samples. For example, in areas of the Branford Harbor marsh (Connecticut), intertidal alterniflora is moving fairly rapidly out over the bordering mudflat. Here a 1-m-deep core of peat taken 50 m from the marsh edge revealed a thin layer of patens peat overlying alterniflora peat that was only 200 years old at the base (Figure 2). A second sample taken much farther back on the same marsh has the more predictable radiocarbon age of 820 ± 140 years. This date compares favorably with 1180 years for a 1-m core from a nearby Guilford marsh (Sears 1963). A third peat sample from the Cottrell marsh in Stonington (Connecticut) produced a radiocarbon age of more than 1655 ± 155 years at 1 meter.

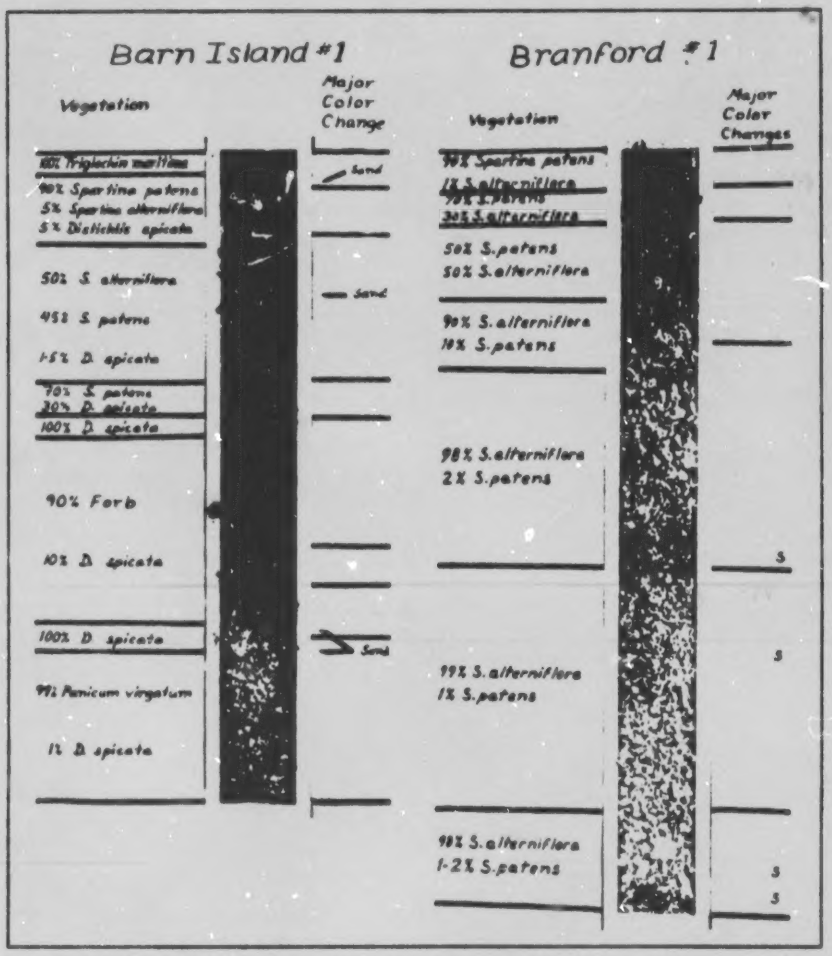
Barn Island #1
Vegetation
Major Color Change
100% Triglochin maritima
90% Spartina patens
5% Spartina alterniflora
5% Distichlis spicata
Sand
50% S. alterniflora
45% S. patens
1-5% D. spicata
Sand
70% S. patens
30% D. spicata
100% D. spicata
90% Forb
10% D. spicata
100% D. spicata
Sand
99% Panicum virgatum
1% D. spicata
Branford #1
Vegetation
Major Color Changes
99% Spartina patens
1% S. alterniflora
70% S. patens
30% S. alterniflora
50% S. patens
50% S. alterniflora
90% S. alterniflora
10% S. patens
98% S. alterniflora
2% S. patens
S
S
99% S. alterniflora
1% S. patens
98% S. alterniflora
1-2% S. patens
S
S

Figure 2. Peat profiles showing marsh development landward over upland soils (Barn Island #1) and seaward over marine sediments (Branford #1). Barn Island shows initial establishment of switch grass (*Panicum virgatum*) in mineral soil and subsequent replacement by spike grass (*Distichlis spicata*) and forbs as the sea level rose over the adjacent upland. This marsh vegetation was eventually replaced by *Spartina* grasses. Within the last few decades, forbs—including arrow grass (*Triglochin maritima*)—have replaced the *Spartina*. Note location of topmost sand line, which probably represents the 1938 hurricane. Total depth of peat core was 84 cm. At Branford, marsh development initiated by alterniflora on silty clay marine sediments along the Branford River. With continued marsh building, this tall intertidal grass was replaced by the high marsh salt-meadow cordgrass (*Spartina patens*). Total depth of core was 97 cm. S represents sand lines.

VEGETATION PATTERN AND DYNAMICS

Most New England marshes feature a typical belting pattern, which is largely related to tidal influences. In Connecticut, Nichols (1920) and Miller and Egler (1950) described a bay-to-upland sequence of belts, which included tall alterniflora along the intertidal zone, patens on the high marsh, black grass (*Juncus gerardi*) near the upland, and switch grass (*Panicum virgatum*) along the marsh-upland interface. However, they recognized that this pattern is complicated by many environmental variables, resulting in a mosaic of vegetation types.

In an attempt to refine our understanding of the marsh vegetation of Connecticut, we surveyed more than 100 marsh systems along the north shore of Long Island Sound, ranging from 2 to 360 ha, in 1973 (Niering and Warren 1974). Detailed microrelief studies were also undertaken on 10 representative marshes (Niering and Warren 1975). Although the Miller and Egler pattern was found to be generally valid, Figure 3 attempts to depict the complexity and variations of the pattern from the bay front to the upland for the southern New England marshes. Along the creeks and bay fronts, a pure stand of tall alterniflora 1-2.5 m in height is closely correlated with mean high tide or daily tidal inundation. With increasing tidal range, a smaller intermediate form 0.5-1.5 m in height occurs as one moves inland from the bay front. This appears to be related to differential tidal flushing.

Landward, the low marsh is replaced by high marsh patens or short alterniflora. Behind the tall alterniflora, a broad levee a few centimeters higher than the average elevation of the high marsh usually develops. Here, pure stands of patens often dominate, but black grass or spike grass (*Distichlis spicata*) may also occur intermixed or as pure stands. Beyond the levee, patens may dominate, but the extensive mosquito ditch pattern causes large areas of short alterniflora (less than 0.5 m in height) to be more common. This development appears to be related to the patens-dominated minilevees along the ditch margins, which tend to trap water and create wetter conditions that favor the short ecophene of alterniflora (Shea et al. 1975).

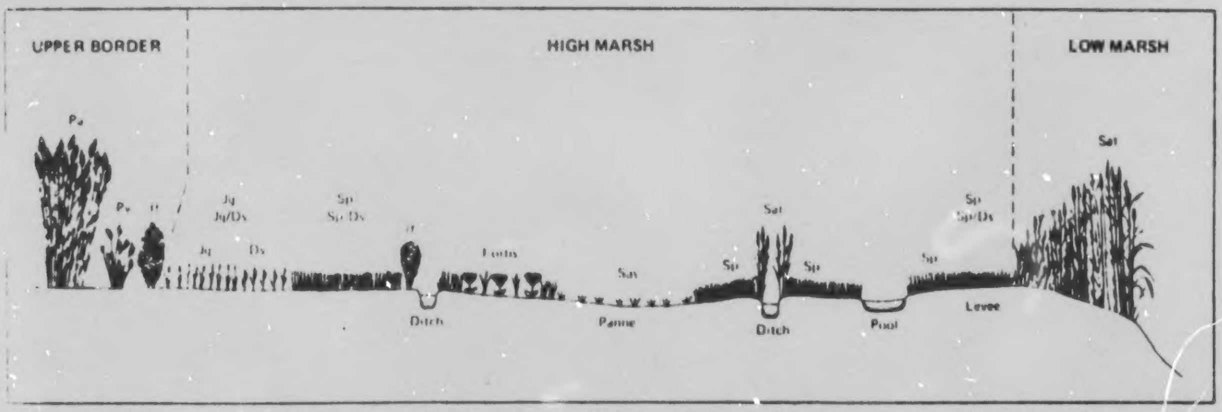

Figure 3. Generalized vegetation bisect from intertidal zone to upland showing major vegetation types that may be encountered on southern New England marshes. Key to symbols: Sat = *Spartina alterniflora*, tall; Sp = *Spartina patens*; Ds = *Distichlis spicata*; Sas = *S. alterniflora*, short; If = *Iva frutescens*; Jg = *Juncus gerardi*; Pv = *Panicum virgatum*; Pa = *Phragmites australis*.

Short alterniflora pannes or slight depressions can also develop naturally on the marsh, and these may persist for decades. Where short alterniflora does not occur, there will usually still be extensive cowlicked stands of nearly pure patens. A mixed forb community—including sea lavender *(Limonium carolinianum)*, marsh gerardia *(Gerardia maritima)*, seaside plantain *(Plantago maritima)*, and arrow grass *(Triglochin maritima)*—may also dominate interditch pannes. Forb patches are as likely to be on slight bumps as in pannes, and our peat core analysis indicates that they are a much more temporary vegetation type.

Several other vegetation features are frequently seen on the high marsh. The well-flushed mosquito ditches are usually lined by tall or intermediate alterniflora. On recently exposed peat, the annual glasswort *(Salicornia europaea)* is the typical colonizer, and it may persist for several seasons or be replaced by any one or a combination of marsh grasses. In pools on the high marsh, now rare due to mosquito ditching, ditch grass *(Ruppia maritima)*—a submerged aquatic of high waterfowl value—may completely dominate the open water. Shallow pools, which tend to collect tidal waters and periodically dry out, usually develop an algal coating and lack vascular plants.

Spike grass, the most ubiquitous species on the high marsh, usually occurs mixed with patens, black grass, and—at times—stunted alterniflora. It grows occasionally in pure stands and generally on wetter sites. Black grass, which is typical near the upland, may also occur in patches on the high marsh. It may be in relict stands, which became established when local conditions were more favorable, or in areas of locally higher elevation. On the high marsh, the frequent occurrence of relatively pure grass communities appears related to interspecific competition due to the dense root mat and continuous above-ground cover. The marsh elder shrub *(Iva frutescens)* also penetrates onto the high marsh, especially on mosquito ditch levees.

Often there are belts of black grass or spike grass or a mixture of the two near the upland. The presence of black grass nearest the upland may be related to the absence of salt glands in this species and the presence of freshwater seepage or runoff. However, its presence on the high marsh adds an intriguing question concerning the factors controlling its distribution. Over the past three decades, the black-grass belt recognized by Miller and Egler (1950) at Barn Island has been largely replaced by arrow grass. Impounding of the upper valley and rising sea level appear to be among the factors involved in this dramatic change.

Along the upper border, switch grass may form a belt along with marsh elder. Where disturbance has occurred along the marsh border, reed grass *(Phragmites australis)* dominates. In areas where the upland slope is very gradual, we have observed switch grass giving way to spike grass as result of rising sea level. Our peat cores have documented this pattern, as shown in Figure 2, where switch grass rhizomes within mineral soil were replaced by spike grass as the marsh encroached landward.

Tidal marsh vegetation is highly dynamic, and our field observations and peat core studies have shown that traditional successional concepts are of limited value in terms of interpreting vegetation change. During marsh development, one can predict that intertidal alterniflora may be replaced by patens high marsh and upper border species by other species, but once the high marsh is formed there are endless combinations of vegetation change that can occur (Chapman 1940). For example, on Barn Island the distinctive belting reported by Miller and Egler (1950) several decades ago no longer exists[1] (Coleman 1978). The black grass belt is essentially gone, the vast expanses of patens high marsh have been largely replaced by short alterniflora, and switch grass by spike grass or marsh elder. As Miller and Egler (1950) stated: "The present mosaic may be thought of as a momentary expression, different in the past and destined to be different in the future and yet as typical as would be a photograph of moving clouds."

FACTOR INTERACTIONS AND SPECIES DISTRIBUTION

The vegetation pattern is influenced by a complex of environmental factors including hydroperiod (the frequency and duration of tidal flooding), salinity, microrelief, substrate, nutrient and oxygen availability, ice-scouring, and storms. In addition, historical factors—including diking, mowing, grazing, and ditching—have also had an impact.

Hydroperiod and soil salinity have been the most intensively studied variables influencing species distribution. On Long Island, Johnson and York (1915) found that the transition from low marsh intertidal alterniflora to high marsh patens generally occurred at elevations within 3 cm of mean high water. This change from low marsh to high marsh at ± 3 to 6 cm has also been confirmed elsewhere (Adams 1963, Niering and Warren 1974, Steever 1972), although considerable local variation occurs (Chapman 1939). The transition from high marsh to the upper border is also related to tidal flooding, with an elevation at about mean spring high water.

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[1] F. E. Egler, Aton Forest, Norfolk, CT, personal communication, 18 October 1974.

The important factors on the high marsh, where a complex vegetation mosaic occurs, are salinity coupled with hydroperiod and soil oxygen availability, rather than flooding frequency alone. Salinity in tidal marsh soils can show considerable spatial and temporal variability, and often there are field correlations between areas of high and low salinity and species distribution. However, limited controlled culture work indicates that most marsh grasses have broadly overlapping salt tolerances (Parrondo et al. 1978, Taylor 1938). Since most species grow fairly well at soil salinities of 15-30 ppt, this salinity range probably does not significantly influence distribution. In fact, a typical vegetation mosaic, including short alterniflora, can thrive under essentially isohaline (25-27 ppt) conditions (Roberts 1976).

Extremes in salinity do occur, however, and where they do they are very important. High marsh pannes can develop salinities of 40-60 ppt, and this is correlated with the distribution of short alterniflora (Adams 1963, Nestler 1977, Roberts 1976). At 35-40 ppt, black grass and patens are essentially eliminated. Spike grass can survive somewhat higher levels; in controlled experiments, it even appears to be more salt-tolerant than alterniflora (Parrondo et al. 1978). Where salinities persist above 55 ppt, short alterniflora is eliminated.

In North Carolina, Adams (1963) suggested that available nutrients might differentially limit growth and distribution of marsh grasses. When he found that alterniflora had a relatively high iron requirement, he argued that this helped limit its distribution to the low marsh while contributing to its short habit on high marsh sites. Working with seedlings, Mooring et al. (1971) also reported a high iron requirement for alterniflora. Recently, however, Roberts (1976) found no evidence that iron was limiting alterniflora distribution. Valiela et al. (1978) have done considerable work on the growth response of alterniflora to applied nitrogen. Although increased nitrogen may stimulate its growth, recent studies do not substantiate nitrogen in alterniflora distribution (Mendelssohn 1979, Nestler 1977, Roberts 1976). In fact, there is no evidence that nutrient availability alone functions as an important factor in controlling the vegetation pattern.

Soil oxygen availability may strongly influence both the distribution and height of alterniflora (Linthurst 1979, 1980, Romig 1973, Woodhn 1976). With the incoming tide, intertidal tall alterniflora sites show a strong rise in soil oxygen. In contrast, oxygen remains very low in the peat of high marsh short alterniflora during the tidal cycle. Possibly the extensive lacunal systems of the peat's rhizomes (Teal and Kanwisher 1966) permit its persistence in highly saline anoxic sites, while the more salt-tolerant spike grass cannot persist.

Natural disturbances, including major storms, deposition of flotsam, ice-scouring, the current rapid rise in sea level, erosion, and deposition processes, can also affect the vegetation pattern. Portions of the intertidal alterniflora belt can be literally removed by severe erosion and ice-scouring. Storms can carry blocks of living vegetation and deposit them on the high marsh. Dead bare spots resulting from the prolonged deposition of flotsam may form pannes or result in bare glasswort-dominated areas. Other bared areas due to erosion or ice-scouring may be colonized by spike grass or forbs (Niering and Warren 1974). The deposition of sediments during storms may also provide sites for the establishment of intertidal alterniflora marsh (Redfield 1972). Thus, a complex set of interacting factors operates at many levels and intensities over time and differentially affects various marshes, resulting in their differing vegetation patterns.

MARSH PRODUCTIVITY

Turner (1976) and Reimold (1977) recently reviewed the productivity of the Atlantic tidal marsh angiosperms. In New England, total angiosperm production from entire marsh systems has been estimated for only a few marshes. Steever (1972) calculated that 88 metric tons of vascular vegetation were produced annually from the 12-ha Cottrell marsh (650 g/m^2/year). Standing crop ranged from 150-820 g/m^2/yr, compared to 430-840 g/m^2/yr in Rhode Island (Nixon and Oviatt 1973a). On the 24-ha Branford marsh, above-ground production averaged 950 g/m^2/yr. On Long Island, O'Connor and Terry (1972) calculated that the 8790 ha of tidal wetlands produce about 53,000 metric tons per year of above-ground vegetation (610 g/m^2/yr). If we add the 6100 ha of Connecticut's marshes on the north side of Long Island Sound (using Steever's estimate of production), we have more than 93,000 metric tons of plant material potentially available as a source of detritis in Long Island Sound.

Turner (1976) found that southern marshes with longer growing seasons and greater solar energy input tend to be more productive than northern marshes. However, considerable variation can occur, depending upon available nutrients, particularly nitrogen (Nixon and Oviatt 1973b, Valiela et al. 1978), and tidal amplitude (Odum and Fanning 1973, Steever et al. 1976). Valiela et al. (1978), among many others, have reported increased productivity of high marsh alterniflora with additions of soil nitrogen. Alterniflora production on several Narragansett Bay marshes also showed strong correlations between soluble ammonia and sediment nitrogen and phosphorus (Nixon and Oviatt 1973b).

Odum and Fanning (1973) have suggested that work done by tidal action provides, in some undefined way, an "energy subsidy" to tidal marsh-estuarine ecosystems—a subsidy analogous to the energy subsidy provided to agricultural ecosystems by cultivation, fertilizers, etc. They propose that this is one of the factors contributing to the extremely high productivity of estuarine ecosystems.

The tidal marshes of Long Island Sound comprise a nearly ideal system with which to test this hypothesis critically. With the exception of tidal amplitude, no detectable environmental gradients (Bowman 1977) occur along the entire Connecticut shoreline. At the eastern end of the sound, the mean tide range is about 0.8 m; at the New York border, it is more than 2 m. Parallel to this tidal range gradient is a productivity gradient for above-ground alterniflora about 800 g/m^2/yr at the Rhode Island border to more than 2000 g/m^2/yr in Greenwich, at the western end of the state. Sampling at 10 marshes spaced fairly evenly along the coast reveals a correlation coefficient of more than 0.95 for productivity against tide range. A similarly high correlation occurs in Narragansett Bay and, to a lesser extent, along the entire Atlantic coast (Figure 4) (Steever et al. 1976).

Although correlation does not prove causality, this high a correlation coefficient in a natural system strongly suggests some causal relationship, and we

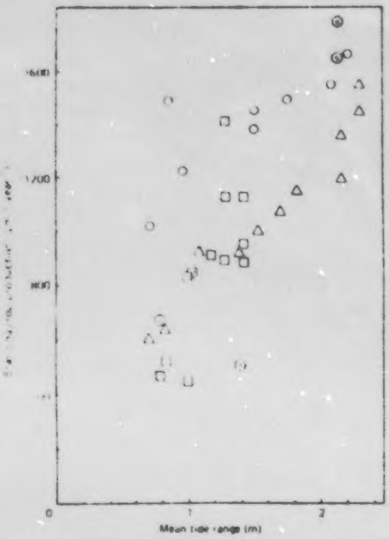

Figure 4. Production of intertidal *S. alterniflora* vs mean tide range for various Atlantic coastal marshes. Key: circles = Long Island Sound (Niering and Warren 1974); triangles = Long Island Sound (Steever 1972); squares = Narrangansett Bay (Nixon and Oviatt 1973a); hexagons = (1) North Carolina (Williams and Murdoch 1969), (2) New Jersey (Good 1965), (3) Long Island (Udell et al. 1969), (4) Sapelo Island, Georgia (mean from Cruz 1973), (5) Sapelo Island, Georgia (value for intertidal *S. alterniflora* Gallagher et al. 1972).

have presented this as evidence supporting the tidal energy subsidy hypothesis. The exact nature of the work done by tidal action in increasing productivity is not clear. However, there is evidence that oxygenation of intertidal peat may well be important (Linthurst 1979, 1980, Romig 1973, Woodfin 1976), along with circulation and replenishment of nutrients.

ENVIRONMENTAL IMPACTS

Prior to recent protective legislation, the tidal wetlands of southern New England were severely affected by man. Of the 24,000 ha reported in Massachusetts in 1950, only 18,000 ha remained by 1963 (Nickerson 1978). In Connecticut, 50% of the tidal marshes had been destroyed by 1965 (Niering and Bowers 1966). On Long Island, more than 1600 ha were lost between 1964 and 1971 (O'Connor and Terry 1972). Although legislation and pressure for enforcement by individuals and private groups such as the Connecticut Conservation Association have greatly reduced direct destruction, numerous degrading impacts still occur. Locally, industrial pollution, excessive sewage enrichment, and occasional oil spills adversely affect the marsh community.

One of the most subtle impacts has been causeway construction, which alters normal tidal flushing. Another is the installation of tidal gates crossing valley marshes to prevent residential flooding during storms or to control the mosquito. This reduces salinity and converts *Spartina*-dominated marshes to reed grass, as documented by our peat core studies (Niering et al. 1977). Up to 10% of Connecticut's coastal marshes may now be dominated by reed grass. Although this species is a most useful resource in some parts of the world (Haslam 1973), dense pure stands are a fire hazard and dry out the marsh substrate (Roman 1978), thus adding economic pressure to develop such sites. The perfection and installation of a self-regulating tidal gate in Fairfield, Connecticut (Steinke 1974), indicate that reed-grass-dominated areas can be restored (Figure 5).

The creation and continued maintenance of mosquito ditches have had highly variable impacts: tall alterniflora can be replaced by woody species (Bourn and Cottam 1950), and short alterniflora can be converted to patens (Britton et al. 1915). Mini-levees along the ditches due to peat deposition can result in widespread vegetation change. The impact of new maintenance techniques which spew a peat slurry over the marsh grasses needs critical evaluation.

The role of marsh restoration of intertidal alterniflora has been successful in Connecticut and elsewhere along the Atlantic coast (Garbisch et al. 1973, Woodhouse et al. 1972). Although it has considerable potential in creating new marsh sites, especially on dredged materials (Wentz et al. 1974), it must be kept in proper ecological perspective and not be used as a license to destroy valuable mudflats or viable marsh systems.

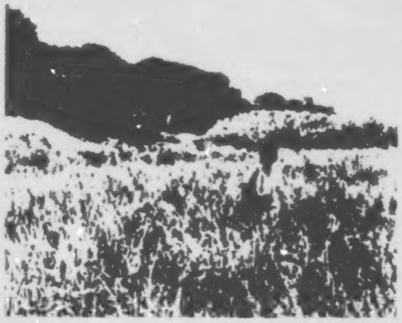

Figure 5. Former reed-grass (*Phragmites australis*)-dominated marsh in Fairfield, Connecticut, restored to saltwater cordgrass (*Spartina alterniflora*) marsh by excavation of reed grass and planting 10 cm plugs of intertidal alterniflora. Planted July 1975; photographed July 1979 (by Thomas J. Steinke). Decrease in height of surrounding reed grass border in background is correlated with presence of tidal creek and increased salinity.

To protect further the integrity of the New England marshes, we recommend replacing tidal restricting structures with self-regulating gates and elevating new causeways across valley marshes to permit full tidal flushing. A 15-30-m upland buffer zone should also be maintained between the upper border of wetland and development.

Further research should attempt to identify (a) factor interactions influencing species distribution; (b) linkage of marsh and estuarine nutrient cycles and productivity as related to coastal zone productivity; and (c) the potential role of coastal wetlands in pollution filtration.

ACKNOWLEDGMENTS

This research was supported, in part, by a grant from the Seth Sprague Educational and Charitable Foundation.

We wish to thank Richard H. Goodwin for his critical reading of the manuscript.

REFERENCES CITED

Adams, D. A. 1963. Factors influencing vascular plant zonation in North Carolina salt marshes. *Ecology* 44: 445-456.

Bloom, A. L., and M. Stuiver. 1963. Submergence of the Connecticut coast. *Science* 139: 332-334.

Bourn, W. S., and C. Cottam. 1950. Some Biological Effects of Ditching Tidewater Marshes. U.S. Department of the Interior, Fish and Wildlife Service, Research Report 19, Washington, DC.

Bowman, M. J. 1977. Nutrient distributions and transport in Long Island Sound. *Estuarine Coastal Mar. Sci.* 5: 531-548.

Britton, W. E., B. H. Walden, and P. L. Buttrick. 1915. Changes in the Vegetation of Salt Marshes Resulting from Ditching. Connecticut Experiment Station Report, New Haven.

Chapman, V. J. 1939. Studies in salt marsh ecology. Sections IV-V. *J. Ecol.* 27: 160-201.

———. 1940. Succession on the New England salt marshes. *Ecology* 21: 279-282.

———. 1960. *Salt Marshes and Salt Deserts of the World.* Interscience Pub., New York.

Coleman, W. B. 1978. Vegetation of the Wequetequock-Pawcatuck Marshes, Stonington, Connecticut—A Comparative Study, 1948 and 1976. Unpublished M.A. thesis, Smith College, Northhampton, MA.

BEST COPY AVAILABLE

9-7

Cruz, A. A. de la. 1973. The role of tidal marshes in the productivity of coastal waters. *Association of Southeastern Biologists Bulletin* 20: 147-156.

Elliott, G. K. 1972. The Great Marsh, Lewes, Delaware. The Physiography, Classification and Geologic History of a Coastal Marsh. University of Delaware College of Marine Studies Technical Report 19. Newark, DE.

Flessa, K. W., K. J. Constantine, and M. K. Cushman. 1977. Sedimentation rates in a coastal marsh determined from historical records. *Chesapeake Sci.* 18: 172-176.

Gallagher, J. L., R. B. Reimold, and D. E. Thompson. 1972. Remote sensing and salt marsh productivity. Pages 338-348 in *Proceedings of the 38th Annual Meeting of the American Society of Photogrammetry*. ASP, Washington, DC.

Garbisch, E. W., Jr., P. B. Woller, W. J. Bostian, and R. J. McCallum. 1973. *Biotic Techniques for Shore Stabilization*. 2nd International Estuarine Research Conference. (Available from Environmental Concern, Inc., P.O. Box P, St. Michaels, MD 11663.)

Good, R. E. 1965. Salt marsh vegetation, Cape May, New Jersey. *N.J. Acad. Sci. Bull.* 10: 1-11.

Gosselink, J. G., E. P. Odum, and R. M. Pope. 1974. The value of the tidal marsh. Louisiana State University, Center for Wetland Resources. Pub. no. LSU-SG-74-03. Baton Rouge, LA.

Grant, R. R., Jr., and R. Patrick. 1970. Tinicum Marsh as a water purifier. Pages 105-123 in *Two Studies of Tinicum Marsh*. The Conservation Foundation, Washington, DC.

Harrison, E. Z., and A. L. Bloom. 1977. Sedimentation rates on tidal salt marshes in Connecticut. *J. Sediment. Petrol.* 47: 1484-1490.

Haslam, S. M. 1973. Some aspects of the life history and autecology of *Phragmites communis* Trin. A Review. *Pol. Arch. Hydrobiol.* 20: 79-100.

Hicks, S. D., and J. E. Crosby. 1974. Trends and Variability in Mean Sea Level, 1893-1972. NOAA Tech. Memo. 13. Washington, DC.

Johnson, D. S., and H. H. York. 1915. *The Relation of Plants to Tide Levels*. Pub. 206, Carnegie Institution, Washington, DC.

Keene, H. W. 1971. Postglacial submergence and salt marsh evolution in New Hampshire. *Marit. Sediments* 7: 64-68.

Linthurst, R. A. 1979. The effect of aeration on the growth of *Spartina alterniflora* Loisel. *Am. J. Bot.* 66: 685-691.

———. 1980. A growth comparison of *Spartina alterniflora* Loisel. ecophenes under aerobic and anaerobic conditions. *Am. J. Bot.*, in press.

McCaffrey, R. J. 1977. A Record of the Accumulation of Sediment and Trace Metals in a Connecticut, U.S.A., Salt Marsh. Unpublished Ph.D. thesis, Yale University, New Haven, CT.

Mendelssohn, I. A. 1979. Nitrogen metabolism in the height forms of *Spartina alterniflora* in North Carolina. *Ecology* 60: 547-584.

Miller, W. R., and F. E. Egler. 1950. Vegetation of the Wequetequock-Pawcatuck tidal-marshes. *Conn. Ecol. Monogr.* 20: 143-172.

Mooring, M. T., A. W. Cooper, and E. D. Seneca. 1971. Seed germination response and evidence for height ecophenes in *Spartina alterniflora* from North Carolina. *Am. J. Bot.* 58: 48-55.

Nestler, J. 1977. Interstitial salinity as a cause of ecophenic variation in *Spartina alterniflora*. *Estuarine Coastal Mar. Sci.* 5: 707-714.

Nichols, G. E. 1920. The vegetation of Connecticut. VI. The plant association of eroding areas along the seacoast. *Bull. Torrey Bot. Club* 47: 511-548.

Nickerson, N.H. 1978. Protection of Massachusetts' wetlands by order of conditions issued by local Conservation Commissions. Pages 69-76 in *Proceedings of National Wetland Protection Symposium*. U.S. Department of the Interior, Washington, DC.

Niering, W. A., and R. M. Bowers. 1966. Our disappearing tidal marshes—their present status. *Conn. Arbor. Bull.* 12 (1961). Second printing.

Niering, W. A., and R. S. Warren. 1974. *Tidal Wetlands of Connecticut I: Vegetation and Associated Animal Populations*. Department of Environmental Protection, State of Connecticut, Hartford.

———. 1975. *Tidal Wetlands of Connecticut, Vegetation and Micro-Relief. II. pt. 4: Micro-relief*. Department of Environmental Protection, State of Connecticut, Hartford.

Niering, W. A., R. S. Warren, and C. G. Weymouth. 1977. Our dynamic tidal marshes: vegetation changes as revealed by peat analysis. *Conn. Arbor. Bull.* 22.

Nixon, S. W., and C. A. Oviatt. 1973a. Ecology of a New England salt marsh. *Ecol. Monogr.* 43: 463-498.

———. 1973b. Analysis of local variation in the standing crop *Spartina alterniflora*. *Bot. Mar.* 16: 103-109.

O'Connor, J. S., and O. W. Terry. 1972. *The Marine Wetlands of Nassau and Suffolk Counties, New York*. Marine Science Research Center, State University of New York at Stony Brook.

Odum, E. P., and M. E. Fanning. 1873. Comparison of the productivity of *Spartina alterniflora* and *Spartina cynosuroides* in Georgia coastal marshes. *Ga. Acad. Sci. Bull.* 31: 1-12.

Odum, W. E., and S. S. Skjei. 1974. The issue of wetlands preservation and management: a second view. *Coastal Zone Man. J.* 1: 151-163.

Parrondo, R. T., J. G. Gosselink, and C. S. Hopkinson. 1978. Effects of salinity and drainage on the growth of three salt marsh grasses. *Bot. Gaz.* 139: 102-107.

Redfield, A. C. 1965. Ontogeny of a salt marsh estuary. *Science* 147: 50-55.

———. 1972. Development of a New England salt marsh. *Ecol. Monogr.* 42: 201-237.

Reimold, R. J. 1977. Mangals and salt marshes of eastern United States. Pages 157-166 in V. J. Chapman, ed. *Wet Coastal Ecosystems*. Elsevier Scientific Publishing Co., Amsterdam.

Roberts, D. T. 1976. The Effects of Nitrogen and Iron Enrichments on *Spartina alterniflora* on Two Connecticut Tidal Marshes. Unpublished M.A. thesis, Connecticut College, New London, CT.

Roman, C. T. 1978. Tidal Restriction: Its Impact on the Vegetation of Six Connecticut Coastal Marshes. Unpublished M.A. thesis, Connecticut College, New London, CT.

Romig, R. F. 1973. Growth and Reproduction of *Spartina*. Unpublished Ph.D. thesis, University of Delaware. University Microfilms, Ann Arbor, MI.

Sanders, J. E., and C. W. Ellis. 1961. Geological aspects of Connecticut's coastal marshes. *Conn. Arbor. Bull.* 12: 16-20.

Sears, P. B. 1963. Vegetation, climate and coastal submergence. *Science* 140: 59-60.

Shea, M. L., R. S. Warren, and W. A. Niering. 1975. Biochemical and transplantation studies of the growth form of *Spartina alterniflora* on Connecticut salt marshes. *Ecology* 56: 461-466.

Steever, E. Z. 1972. Productivity and Vegetation Studies of a Tidal Salt Marsh in Stonington, Connecticut: Cottrell Marsh. Unpublished M.A. thesis, Connecticut College, New London, CT.

Steever, E. Z., R. S. Warren, and W. A. Niering. 1976. Tidal energy subsidy and standing crop production of *Spartina alterniflora*. *Estuarine Coastal Mar. Sci.* 4: 473-478.

Steinke, T. J. 1974. *A Proposal Concerning the Restoration of the Pine Creek Estuary, Fairfield, Connecticut*. Fairfield Conservation Commission, Fairfield, CT.

Taylor, N. 1938. A preliminary report on the salt marsh vegetation of Long Island, New York. *N.Y. State Mus. Bull.* 316: 21-84.

Teal, M. M. 1962. Energy flow in the salt marsh ecosystem of Georgia. *Ecology* 43: 614-624.

Teal, J. M. and J. Kanwisher. 1966. Gas transport in the marsh grass, *Spartina alterniflora*. *J. Exp. Bot.* 17: 355-361.

Turner, R. E. 1976. Geographic variations in salt marsh macrophyte production: a review. *Contrib. Mar. Sci.* 20: 47-68.

Udell, H. F., J. Zarudsky, T. E. Doheny, and P. R. Burkholder. 1969. Productivity and nutrient values of plants growing in the salt marshes of the town of Hempstead, Long Island. *Bull. Torrey Bot. Club* 96: 42-51.

Valiela, I., J. M. Teal, and W. G. Deuser. 1978. The nature of growth forms in the salt marsh grass *Spartina alterniflora*. *Am. Nat.* 112: 461-470.

Welsh, B. L. 1980. Comparative nutrient dynamics of a marsh-mudflat ecosystem. *Estuarine Coastal Mar. Sci.*, in press.

Wentz, W. A., R. L. Smith, and J. A. Kadlec

BEST COPY AVAILABLE

9-8

1974. *State-of-the-Art Survey and Evaluation of Marsh Plant Establishment Techniques: Induced and Natural. II. A Selected Annotated Bibliography on Aquatic and Marsh Plants and Their Management.* University of Michigan, School of Natural Resources, Ann Arbor, MI.

Williams, R. B., and M. B. Murdoch. 1969. The potential importance of *Spartina alterniflora* in conveying zinc, manganese and iron into estuarine food chains. Pages 431-439 in *Proceedings of 2nd National Symposium on Radioecology.* U.S. Atomic Energy Commission, Washington, DC.

Windom, H. L. 1977. Ability of Salt Marshes to Remove Nutrients and Heavy Metals from Dredged Materials Disposal Area Effluents. U.S. Army Eng. Waterways Expt. Sta. Tech. Rept. D-77-37, Vicksburg, MS.

Woodlin, F. S. 1976. Soil oxygen diffusion and photosynthetic rates of *Spartina alterniflora* in Connecticut salt marshes. Unpublished M.A. thesis, Connecticut College, New London, CT.

Woodhouse, W. W., Jr., E. D. Seneca, and S. W. Broome. 1972. Marsh building with dredge spoil in North Carolina. North Carolina State University at Raleigh, *Ag. Expt. Sta. Bull.* 445.

Woodwell, G. M., and D. E. Whitney. 1977. Flax Pond ecosystem study: exchanges of phosphorus between a salt marsh and the coastal waters of Long Island Sound. *Mar. Biol.* 41: 1-6.

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Please limit address to 4 lines with no more than 29 characters per line. Abbreviate where possible.

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The Hound of the Baskervilles *

With long bounds the huge black creature was leaping down the track, following hard upon the footsteps of our friend. So paralyzed were we by the apparition that we allowed him to pass before we had recovered our nerve. Then Holmes and I both fired together, and the creature gave a hideous howl, which showed that one at least had hit him. He did not pause, however, but bounded onwards. Far away on the path we saw Sir Henry looking back, his face white in the moonlight, his hands raised in horror, glaring helplessly at the frightful thing which was hunting him down.

But that cry of pain from the hound had blown all our fears to the winds. If he was vulnerable he was mortal, and if we could wound him we could kill him. Never have I seen a man run as Holmes ran that night. I am reckoned fleet of foot, but he outpaced me as much as I outpaced the little professional. In front of us as we flew up the

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* Taken from "The Hound of the Baskervilles" by Conan Doyle chapter 14.

9-10

track we heard scream after scream from Sir Henry and the deep roar of the hound. I was in time to see the beast spring upon its victim, hurl him to the ground, and worry at his throat. But the next instant Holmes had emptied five barrels of his revolver into the creature's flank. With a last howl of agony and a vicious snap in the air it rolled upon its back, four feet pawing furiously, and then fell limp upon its side. I stooped, panting, and pressed my pistol to the dreadful, shimmering head, but it was useless to press the trigger. The giant hound was dead.

Sir Henry lay insensible where he had fallen. We tore away his collar, and Holmes breathed a prayer of gratitude when we saw that there was no sign of a wound and that the rescue had been in time. Already our friend's eyelids shivered and he made a feeble effort to move. Lestrade thrust his brandy-flask between the baronet's teeth, and two frightened eyes were looking up at us.

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9-11

"My God!" he whispered. "What was it? What, in Heaven's name, was it?"

"It's dead, whatever it is," said Holmes. "We've laid the family ghost once and for ever."

In mere size and strength it was a terrible creature which was lying stretched before us. It was not a pure bloodhound and it was not a pure mastiff; but it appeared to be a combination of the two—gaunt, savage, and as large as a small lioness. Even now, in the stillness of death, the huge jaws seemed to be dripping with a bluish flame, and the small, deep-set, cruel eyes were ringed with fire. I placed my hand upon the glowing muzzle, and as I held them up my own fingers smouldered and gleamed in the darkness.

"Phosphorus," I said.

"A cunning preparation of it," said Holmes, sniffing at the dead animal. "There is no smell which might have interfered with his power of scent. We owe you a deep apology, Sir Henry, for having exposed you

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9-12

to this fright. I was prepared for a hound, but not for such a creature as this. And the fog gave us little time to receive him."

"You have saved my life."

"Having first endangered it. Are you strong enough to stand?"

"Give me another mouthful of that brandy, and I shall be ready for anything. So! Now, if you will help me up. What do you propose to do?"

"To leave you here. You are not fit for further adventures to-night. If you will wait, one or other of us will go back with you to the Hall."

He tried to stagger to his feet; but he was still ghastly pale and trembling in every limb. We helped him to a rock, where he sat shivering with his face buried in his hands.

"We must leave you now," said Holmes. "The rest of our work must be done, and every moment is of importance. We have our case, and now we only want our man.

"It's a thousand to one against our finding

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him at the house," he continued, as we retraced our steps swiftly down the path. "Those shots must have told him that the game was up."

"We were some distance off, and this fog may have deadened them."

"He followed the hound to call him off—of that you may be certain. No, no, he's gone by this time! But we'll search the house and make sure."

The front door was open, so we rushed in and hurried from room to room, to the amazement of a doddering old manservant, who met us in the passage. There was no light save in the dining-room, but Holmes caught up the lamp, and left no corner of the house unexplored. No sign could we see of the man whom we were chasing. On the upper floor, however, one of the bedroom doors was locked.

"There's some one in here!" cried Lestrade. "I can hear a moveme[illegible] Open this door!"

A faint moaning and rustling came from

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9-14

within. Holmes struck the door just over the lock with the flat of his foot, and it flew open. Pistol in hand, we all three rushed into the room.

But there was no sign within it of that desperate and defiant villain whom we expected to see. Instead we were faced by an object so strange and so unexpected that we stood for a moment staring at it in amazement.

The room had been fashioned into a small museum, and the walls were lined by a number of glass-topped cases full of that collection of butterflies and moths the formation of which had been the relaxation of this complex and dangerous man. In the centre of this room there was an upright beam, which had been placed at some period as a support for the old worm-eaten balk of timber which spanned the roof. To this post a figure was tied, so swathed and muffled in the sheets which had been used to secure it that one could not for the moment tell whether it was that of a man or a woman.

One towel passed round the throat, and was secured at the back of the pillar. Another covered the lower part of the face, and over it two dark eyes—eyes full of grief and shame and a dreadful questioning—stared back at us. In a minute we had torn off the gag, unswathed the bonds, and Mrs. Stapleton sank upon the floor in front of us. As her beautiful head fell upon her chest I saw the clear red weal of a whip-lash across her neck.

"The brute!" cried Holmes. "Here, Lestrade, your brandy-bottle! Put her in the chair! She has fainted from ill-usage and exhaustion."

She opened her eyes again. "Is he safe?" she asked. "Has he escaped?"

"He cannot escape us, madam."

"No, no, I did not mean my husband. Sir Henry? Is he safe?"

"Yes."

"And the hound?"

"It is dead."

She gave a long sigh of satisfaction.

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"Thank God! Thank God! Oh, this villain! See how he has treated me!" She shot her arms out from her sleeves, and we saw with horror that they were all mottled with bruises. "But this is nothing—nothing! It is my mind and soul that he has tortured and defiled. I could endure it all, ill-usage, solitude, a life of deception, everything, as long as I could still cling to the hope that I had his love, but now I know that in this also I have been his dupe and his tool." She broke into passionate sobbing as she spoke.

"You bear him no good will, madam," said Holmes. "Tell us, then, where we shall find him. If you have ever aided him in evil, help us now and so atone."

"There is but one place where he can have fled," she answered. "There is an old tin mine on an island in the heart of the Mire. It was there that he kept his hound, and there also he had made preparations so that he might have a refuge. That is where he would fly."

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The Hound of the Baskervilles

The fog-bank lay like white wool against the window. Holmes held the lamp towards it.

"See," said he. "No one could find his way into the Grimpen Mire to-night."

She laughed and clapped her hands. Her eyes and teeth gleamed with fierce merriment.

"He may find his way in, but never out," she cried. "How can he see the guiding wands to-night? We planted them together, he and I, to mark the pathway through the Mire. Oh, if I could only have plucked them out to-day! Then indeed you would have had him at your mercy."

It was evident to us that all pursuit was in vain until the fog had lifted. Meanwhile we left Lestrade in possession of the house, while Holmes and I went back with the baronet to Baskerville Hall. The story of the Stapletons could no longer be withheld from him, but he took the blow bravely when he learned the truth about the woman whom he had loved. But the shock of the

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night's adventures had shattered his nerves, and before morning he lay delirious in a high fever, under the care of Dr. Mortimer. The two of them were destined to travel together round the world before Sir Henry had become once more the hale, hearty man that he had been before he became master of that ill-omened estate.

And now I come rapidly to the conclusion of this singular narrative, in which I have tried to make the reader share those dark fears and vague surmises which clouded our lives so long, and ended in so tragic a manner. On the morning after the death of the hound the fog had lifted and we were guided by Mrs. Stapleton to the point where they had found a pathway through the bog. It helped us to realise the horror of this woman's life when we saw the eagerness and joy with which she laid us on her husband's track. We left her standing upon the thin peninsula of firm, peaty soil which tapered out into the wide-spread bog. From

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9-19

the end of it a small wand planted here and there showed where the path zigzagged from tuft to tuft of rushes among those green-scummed pits and foul quagmires which barred the way to the stranger. Rank reeds and lush, slimy water-plants sent an odour of decay and a heavy miasmatic vapour into our faces, while a false step plunged us more than once thigh-deep into the dark, quivering mire, which shook for yards in soft undulations around our feet. Its tenacious grip plucked at our heels as we walked, and when we sank into it it was as if some malignant hand was tugging us down into those obscene depths, so grim and purposeful was the clutch in which it held us. Once only we saw a trace that some one had passed that perilous way before us. From amid a tuft of cotton-grass which bore it up out of the slime some dark thing was projecting. Holmes sank to his waist as he stepped from the path to seize it, and had we not been there to drag him out he could never have set his foot upon

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9-20

firm land again. He held an old black boot in the air. "Meyers, Toronto," was printed on the leather inside.

"It is worth a mud bath," said he. "It is our friend Sir Henry's missing boot."

"Thrown there by Stapleton in his flight."

"Exactly. He retained it in his hand after using it to set the hound upon his track. He fled when he knew the game was up, still clutching it. And he hurled it away at this point of his flight. We know at least that he came so far in safety."

But more than that we were never destined to know, though there was much which we might surmise. There was no chance of finding footsteps in the mire, for the rising mud oozed swiftly in upon them, but as we at last reached firmer ground beyond the morass we all looked eagerly for them. But no slightest sign of them ever met our eyes. If the earth told a true story, then Stapleton never reached that island of refuge towards which he struggled through the fog upon that last night. Somewhere in the heart of

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the great Grimpen Mire, down in the foul slime of the huge morass which had sucked him in, this cold and cruel-hearted man is for ever buried.

Many traces we find of him in the bog-girt island where he had hid his savage ally. A huge driving-wheel and a shaft half-filled with rubbish showed the position of an abandoned mine. Beside it were the crumbling remains of the cottages of the miners, driven away no doubt by the foul reek of the surrounding swamp. In one of these a staple and chain with a quantity of gnawed bones showed where the animal had been confined. A skeleton with a tangle of brown hair adhering to it lay among the *débris.*

"A dog!" said Holmes. "By Jove, a curly-haired spaniel. Poor Mortimer will never see his pet again. Well, I do not know that this place contains any secret which we have not already fathomed. He could hide his hound, but he could not hush its voice, and hence came those cries which

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even in daylight were not pleasant to hear. On an emergency he could keep the hound in the outhouse at Merripit, but it was always a risk, and it was only on the supreme day, which he regarded as the end of all his efforts, that he dared do it. This paste in the tin is no doubt the luminous mixture with which the creature was daubed. It was suggested, of course, by the story of the family hell-hound, and by the desire to frighten old Sir Charles to death. No wonder the poor devil of a convict ran and screamed, even as our friend did, and as we ourselves might have done, when he saw such a creature bounding through the darkness of the moor upon his track. It was a cunning device, for, apart from the chance of driving your victim to his death, what peasant would venture to inquire too closely into such a creature should he get sight of it, as many have done, upon the moor? I said it in London, Watson, and I say it again now, that never yet have we helped to hunt down a more dangerous man

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than he who is lying yonder"—he swept his long arm towards the huge mottled expanse of green-splotched bog which stretched away until it merged into the russet slopes of the moor.

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Carole Wilson-Janney

Thoughts about different kinds of wetlands came out as Haiku:

The earth's great sponges
Our marshes and swamps, saving
Water for dry times.

The mussels snap shut.
Waiting in the salt marsh flats
For their life, the tides.

The brown water bog.
Just a giant waterbed
With spongy moss sheets.

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The Extinction of Species in the Wetlands

Chapter 10
Activity Sheets

federal register

Tuesday
May 20, 1980

Part II

Department of the Interior

Fish and Wildlife Service

Republication of Lists of Endangered and Threatened Species and Correction of Technical Errors in Final Rules

10-1

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

Republication of the Lists of Endangered and Threatened Species and Correction of Technical Errors in Final Rules

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule; republication of the U.S. Lists of Endangered and Threatened Wildlife and Plants and correction of technical errors.

SUMMARY: The Service hereby issues a republication of the lists of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12. The last republication was January 17, 1979 (44 FR 3636–3654). Technical errors are also corrected.

DATE: These lists include all species listed as of May 10, 1980, and are effective May 20, 1980, except the bonytail chub (final rule effective May 23, 1980) and the Goodenough gambusia (final rule effective May 30, 1980). The texts of 50 CFR 17.11 and 17.12 are also effective May 20, 1980 (*see* 45 FR 13010, February 27, 1980).

ADDRESSES: Comments concerning this republication should be sent to the Director (OES), U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. 20240.

FOR FURTHER INFORMATION CONTACT: Mr. John L. Spinks, Jr., Chief, Office of Endangered Species, Washington, D.C. 20240, (703) 235–2771.

SUPPLEMENTARY INFORMATION: The lists incorporate species officially listed as Endangered or Threatened under the Endangered Species Act of 1973, as amended, and 50 CFR Part 424. The previous republication was January 17, 1979 (44 FR 3636–3654). The animal species added to § 17.11 since that publication are Caribbean monk seal, Ryukyu rabbit, Simien fox, Malabar large spotted civet, Iriomote cat, Fea's muntjac, Formosan sika, Ryukyu sika, North China sika, Shansi sika, South China sika, Corsican red deer, Barbary deer, Yarkand deer, Bactrian deer, western giant eland, Jentink's duiker, Tora hartebeest, Swayne's hartebeest, Zanzibar suni, sand gazelle, Saudi Arabian gazelle, Pelzeln's gazelle, Arabian gazelle, Arabian tahr, West African manatee, Grevy's zebra, Hartmann's zebra, Virginia big-eared bat, Ozark big-eared bat, red-necked parrot, saltwater crocodile, two unnamed boas from Mauritius, Virgin Islands tree boa, San Esteban Island chuckwalla, Fiji banded and Fiji crested iguanas, Bolson tortoise, Plymouth red-bellied turtle, totoaba, bonytail chub, Goodenough gambusia, and Kern primrose sphinx moth. Plant species added to §17.12 are bunched arrowhead, Tennessee purple coneflower, *Lipochaeta venosa*, Truckee barberry, Chapman rhododendron, green pitcher plant, Harper's beauty, purple-spined hedgehog cactus, Wright fishhook cactus, Uinta Basin hookless cactus, Lee pincushion cactus, Arizona hedgehog cactus, Brady pincushion cactus, Siler pincushion cactus, Raven's mazanita, MacFarlane's four-o'clock, Lloyd's hedgehog cactus, black lace cactus, Peebles Navajo cactus, Kuenzler hedgehog cactus, Nicoll's Turk's head cactus, Knowlton cactus, *Stenogyne angustifolia* var. *angustifolia*, *Haplostachys haplostachya* var. *angustifolia*, Cooke's kokio, Mesa Verde cactus, bunched cory cactus, Lloyd's Mariposa cactus, dwarf bear-poppy, Chilean false larch or alerce, *Ancistrocactus tobuschii*, Davis' green pitaya, Nellie cory cactus, Sneed pincushion cactus, spineless hedgehog cactus, Guatemalan fir or pinabete. Some populations of the American alligator have been reclassified and all the non-U.S. populations of the American crocodile were added to the previously listed U.S. population. The following captive self-sustaining populations of species have been removed from the list (*see* the September 17, 1979, **Federal Register** [44 FR 54007]): jaguar, black lemur, ring-tailed lemur, leopard, tiger, brown eared pheasant, Edward's pheasant, bar-tailed pheasant, Mikado pheasant, Palawan peacock pheasant, Swinhoe's pheasant.

Since the republication of the lists is a consolidation of previous rules, and the technical changes are purely to aid the reader, this document is not a rule as contemplated under Executive Order 12044 and 43 CFR 14.2(e). Therefore, the provisions of that rule do not apply, and a determination of significance is not required. In addition, the Service finds for good cause that this document shall be effective as indicated above and that notice and public comment are unnecessary. Technical errors detected in previous lists and the **Federal Register** of February 27, 1980 (45 FR 13010–13026, to be codified at 50 CFR §§ 17.11 and 17.12), have been corrected. Some scientific names have been changed to reflect current usage. Synonyms or alternative names are indicated by (=). Readers are requested to advise the Service of any errors, particularly with regard to the historic ranges of the listed taxa.

Dated: May 14, 1980.

Lynn A. Greenwalt,
Director, Fish and Wildlife Service.

Regulations Promulgation

Accordingly, §§ 17.11 and 17.12 are revised and republished to Title 50 of the Code of Federal Regulations as set forth below:

PART 17—ENDANGERED AND THREATENED WILDLIFE AND PLANTS

1. 50 CFR 17.11 and 17.12 are revised to read as follows:

§ 17.11 Endangered and threatened wildlife.

(a) The list in this section contains the names of all species of wildlife which have been determined by the Director to be Endangered or Threatened. It also contains the names of species of wildlife treated as Endangered or Threatened because they are sufficiently similar in appearance to Endangered or Threatened species (see § 17.50 *et seq.*).

(b) The columns entitled "Common Name", "Scientific Name", and "Vertebrate Population where Endangered or Threatened" define the species of wildlife within the meaning of the Act. Thus, differently classified geographic populations of the same vertebrate subspecies or species shall be identified by their differing geographic boundaries, even though the other two columns are identical. The term "Entire" means that all populations throughout the present range of a vertebrate species are listed. Although common names are included, they cannot be relied upon for identification of any specimen, since they may vary greatly in local usage. The Director shall use the most recently accepted scientific name. In cases in which confusion might arise, a synonym will be provided in parentheses. The Services shall rely to the extent practicable on the *International Code of Zoological Nomenclature*.

(c) In the "Status" column the following symbols are used: "E" for Endangered, "T" for Threatened, and "E [or T] (S/A)" for similarity of appearance species.

(d) For information purposes only, the "Historic Range" indicates the general known distribution of the species or subspecies as reported in the scientific literature. The present distribution may be greatly reduced from this historic range. This column does not imply any limitation on the application of the prohibitions in the Act or implementing rules. Such prohibitions apply to all individuals of the species, wherever found. When the list is updated annually any change in the range will be added.

(e) For informational purposes only, a footnote to the **Federal Register** publication(s) originally listing a species is provided under the column "When Listed." Footnote numbers to §§ 17.11 and 17.12 are in the same numerical sequence, since plants and animals may be listed in the same **Federal Register** document. That document includes a statement indicating the basis for the listing.

(f) The "Special Rules" and "Critical Habitat" columns provide a cross-reference to other sections in Part 17 or Parts 222, 226 or 227. The term "N/A" (not applicable) appearing in either of these two columns indicates that there are no special rules and/or Critical Habitat for that particular species. However, all other appropriate rules in Part 17 and Parts 217–227 and 402 still apply to that species. In addition, there may be other rules in this Title 50 that relate to such wildlife, e.g., port-of-entry requirements. It is not intended that the references in the "Special Rules" column list all the regulations of the two Services which might apply to the species or to the regulations of other Federal agencies or State or local governments.

(g) The listing of a particular taxon includes all lower taxonomic units. For example, the genus *Hylobates* (gibbons) is listed as Endangered throughout its entire range (China, India, and SE Asia); consequently, all species, subspecies, and populations of that genus are considered listed as Endangered for the purposes of the Act. In 1973 (43 FR 6230–6233) the species *Haliaeetus leucocephalus* (bald eagle) was listed as Threatened in "USA (WA, OR, MN, WI, MI)" rather than its entire population; thus, all individuals of the bald eagle found in those five States are considered listed as Threatened for the purposes of the Act.

(h) The "List of Endangered and Threatened Wildlife" is provided below:

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
Anoa	*Bubalus anoa depressicornis*	Indonesia	Entire	E	3	NA	NA
Anoa	*Bubalus anoa quarlesi*	Indonesia	Entire	E	15	NA	NA
Anteater, scaly	*Manis temmincki*	Africa	Entire	E	15	NA	NA
Antelope, bontebok	*Damaliscus dorcas dorcas*	South Africa	Entire	E	15	NA	NA
Antelope, giant sable	*Hippotragus niger variani*	Angola	Entire	E	15	NA	NA
Antelope, Mongolian saiga	*Saiga tatarica mongolica*	Mongolia	Entire	E	15	NA	NA
Argali	*Ovis ammon hodgsoni*	China (Tibet)	Entire	E	15	NA	NA
Armadillo, giant	*Priodontes giganteus*	Venezuela and Guyana to Argentina.	Entire	E	16	NA	NA
Armadillo, pink fairy	*Chlamyphorus truncatus*	Argentina	Entire	E	3	NA	NA
Ass, African wild	*Equus asinus*	Somalia, Sudan, Ethiopia	Entire	E	3	NA	NA
Ass, Asian wild	*Equus hemionus*	Southwestern and Central Asia	Entire	E	3	NA	NA
Avahis	*Avahi* spp. (all species)	Malagasy Republic (= Madagascar).	Entire	E	3	NA	NA
Aye-Aye	*Daubentonia*	Malagasy Republic (= Madagascar).	Entire	E	3	NA	NA
Babirousa	*Babyrousa babyrussa*	Indonesia	Entire	E	15	NA	NA
Bandicoot, barred	*Perameles bougainville*	Australia	Entire	E	4	NA	NA
Bandicoot, desert	*Perameles eremiana*	Australia	Entire	E	6	NA	NA
Bandicoot, lesser rabbit	*Macrotis leucura*	Australia	Entire	E	4	NA	NA
Bandicoot, pig-footed	*Chaeropus ecaudatus*	Australia	Entire	E	4	NA	NA
Bandicoot, rabbit	*Macrotis lagotis*	Australia	Entire	E	4	NA	NA
Banteng	*Bos banteng*	Southeast Asia	Entire	E	3	NA	NA
Bat, gray	*Myotis grisescens*	Central and Southeast U.S.A.	Entire	E	13	NA	NA
Bat, Hawaiian hoary	*Lasiurus cinereus semotus*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Bat, Indiana	*Myotis sodalis*	East and Midwestern U.S.A.	Entire	E	1	17.95(a)	NA
Bat, Ozark big-eared	*Plecotus townsendii ingens*	U.S.A. (MO, OK, AR)	Entire	E	85	NA	NA
Bat, Virginia big-eared	*Plecotus townsendii virginianus*	U.S.A. (KY, WV, VA, IN, IL, OH)	Entire	E	85	17.95(a)	NA
Bear, brown	*Ursus arctos pruinosus*	China (Tibet)	Entire	E	15	NA	NA
Bear, brown	*Ursus arctos arctos*	Palearctic	Italy	E	15	NA	NA
Bear, brown or grizzly	*Ursus arctos horribilis*	Canada, Western U.S.A.	U.S.A.—48 conterminous States.	T	1, 2, 9	NA	17.40(b)
Bear, Mexican grizzly	*Ursus arctos nelsoni*	Mexico	Entire	E	9	NA	NA
Beaver	*Castor fiber birulai*	Mongolia	Entire	E	15	NA	NA
Bison, wood	*Bison bison athabascae*	Canada, Northwest U.S.A.	Canada	E	9	NA	NA
Bobcat	*Felis rufus escuinapae*	Central Mexico	Entire	E	15	NA	NA
Camel, Bactrian	*Camelus bactrianus*	Mongolia, China	Entire	E	15	NA	NA
Cat, Andean	*Felis jacobita*	Chile, Peru, Bolivia, Argentina	Entire	E	15	NA	NA
Cat, black-footed	*Felis nigripes*	Southern Africa	Entire	E	15	NA	NA
Cat, flat-headed	*Felis planiceps*	Malaysia	Entire	E	15	NA	NA
Cat, Iriomote	*Mayailurus iriomotensis*	Japan (Iriomote Island, Ryukyu Islands).	Entire	E	50	NA	NA
Cat, leopard	*Felis bengalensis bengalensis*	Eastern Asia	Entire	E	15	NA	NA
Cat, marbled	*Felis marmorata*	Nepal, Malaysia, Burma, Indonesia.	Entire	E	15	NA	NA
Cat, Temminck's	*Felis temmincki*	China (Tibet), Malaysia, Indonesia (Sumatra).	Entire	E	15	NA	NA
Cat, tiger	*Felis tigrina*	Costa Rica to Northern South America.	Entire	E	5	NA	NA
Chamois, Apennine	*Rupicapra rupicapra ornata*	Italy	Entire	E	15	NA	NA
Cheetah	*Acinonyx jubatus*	Africa to India	Entire	E	3, 5	NA	NA
Chimpanzee	*Pan troglodytes*	West and Central Africa	Entire	T	16	NA	17.40(b)
Chimpanzee, pigmy	*Pan paniscus*	Zaire	Entire	T	16	NA	17.40(b)
Chinchilla	*Chinchilla brevicaudata boliviana*	Bolivia	Entire	E	15	NA	NA
Civet, Malabar large-spotted	*Viverra megaspila civettina*	India	Entire	E	50	NA	NA
Colobus, black	*Colobus satanas*	Equatorial Guinea, People's Republic of Congo, Cameroon, Gabon.	Entire	E	16	NA	NA
Colobus, Tana River red	*Colobus badius rufomitratus*	Kenya	Entire	E	3, 16	NA	NA
Colobus, Zanzibar red	*Colobus kirkii*	Tanzania	Entire	E	3	NA	NA
Cougar, eastern	*Felis concolor cougar*	Eastern North America	Entire	E	6	NA	NA

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Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Deer, Bactrian	*Cervus elaphus bactrianus*	U.S.S.R., Afghanistan	Entire	E	50	NA	NA
Deer, Bawean	*Axis porcinus kuhli*	Indonesia	Entire	E	3	NA	NA
Deer, Barbary	*Cervus elaphus barbarus*	Morocco, Tunisia, Algeria	Entire	E	50	NA	NA
Deer, Cedros Island mule	*Odocoileus hemionus cedrosensis.*	Mexico (Cedros Island)	Entire	E	10	NA	NA
Deer, Columbian white-tailed	*Odocoileus virginianus leucurus*	U.S.A. (WA, OR)	Entire	E	1	NA	NA
Deer, Corsican red	*Cervus elaphus corsicanus*	Corsica, Sardinia	Entire	E	50	NA	NA
Deer, Eld's brown-antlered	*Cervus eldi*	India to Southeast Asia	Entire	E	3	NA	NA
Deer, hog	*Axis (=Cervus) porcinus annamiticus.*	Thailand, Indochina	Entire	E	15	NA	NA
Deer, key	*Odocoileus virginianus clavium*	U.S.A. (southern FL)	Entire	E	1	NA	NA
Deer, marsh	*Blastocerus dichotomus*	Argentina, Uruguay, Paraguay, Brazil.	Entire	E	3	NA	NA
Deer, McNeill's	*Cervus elaphus macneilli*	China (Sinkiang, Tibet)	Entire	E	3	NA	NA
Deer, musk	*Moschus moschiferus moschiferus.*	South-central Asia	Entire	E	15	NA	NA
Deer, pampas	*Ozotoceros bezoarcticus*	Brazil, Argentina, Uruguay, Paraguay.	Entire	E	15	NA	NA
Deer, Persian fallow	*Dama dama mesopotamica*	Iraq, Iran	Entire	E	3	NA	NA
Deer, Philippine	*Axis calamianensis*	Philippines (Calamian Islands)	Entire	E	15	NA	NA
Deer, swamp	*Cervus duvauceli*	India, Nepal	Entire	E	3	NA	NA
Deer, Yarkand	*Cervus elaphus yarkandensis*	China (Sinkiang)	Entire	E	50	NA	NA
Dibbler	*Antechinus apicalis*	Australia	Entire	E	4	NA	NA
Dog, Asiatic wild (=Dhole)	*Cuon alpinus*	U.S.S.R., Korea, China, India, Southeast Asia.	Entire	E	3	NA	NA
Drill	*Papio leucophaeus*	Equatorial West Africa	Entire	E	15	NA	NA
Dugong	*Dugong dugon*	East Africa to southern Japan, including U.S.A. (Trust Territories).	Entire	E	4	NA	NA
Duiker, Jentink's	*Cephalophus jentinki*	Sierra Leone, Liberia, Ivory Coast.	Entire	E	50	NA	NA
Eland, Western giant	*Taurotragus derbianus derbianus*	Senegal to Ivory Coast	Entire	E	50	NA	NA
Elephant, African	*Loxodonta africana*	Africa	Entire	T	40	NA	17 40(e)
Elephant, Asian	*Elephas maximus*	South-central and Southeast Asia	Entire	E	15	NA	NA
Ferret, black-footed	*Mustela nigripes*	Western U.S.A., Western Canada.	Entire	E	1, 3	NA	NA
Forester, Tasmanian (kangaroo)	*Macropus giganteus tasmaniensis*	Australia (Tasmania)	Entire	E	6	NA	NA
Fox, Northern swift	*Vulpes velox hebes*	U.S.A. (northern plains), Canada	Canada	E	3	NA	NA
Fox, San Joaquin kit	*Vulpes macrotis mutica*	U.S.A. (California)	Entire	E	1	NA	NA
Fox, Simien	*Simia simensis*	Ethiopia	Entire	E	50	NA	NA
Gazelle, Clark's (=Dibatag)	*Ammodorcas clarkei*	Somalia, Ethiopia	Entire	E	3	NA	NA
Gazelle, Cuvier's	*Gazella cuvieri*	Morocco, Tunisia	Entire	E	3	NA	NA
Gazelle, Mhorr	*Gazella dama mhorr*	Morocco	Entire	E	3	NA	NA
Gazelle, Moroccan (=Dorcas)	*Gazella dorcas massaesyla*	Morocco, Algeria	Entire	E	3	NA	NA
Gazelle, Rio de Oro Dama	*Gazella dama lozanoi*	Spanish Sahara	Entire	E	3	NA	NA
Gazelle, Arabian	*Gazella gazella*	Arabian Peninsula including Israel	Entire	E	50	NA	NA
Gazelle, Sand	*Gazella subgutturosa marica*	Jordan, Arabian Peninsula	Entire	E	50	NA	NA
Gazelle, Saudi Arabian	*Gazella dorcas saudiya*	Israel, Iraq, Jordan, Syria, Saudi Arabia, Kuwait.	Entire	E	50	NA	NA
Gazelle, Pelzeln's	*Gazella dorcas pelzelni*	Somalia	Entire	E	50	NA	NA
Gazelle, slender-horned (=Rhim)	*Gazella leptoceros*	Sudan, Egypt, Algeria, Libya	Entire	E	3	NA	NA
Gelada (baboon)	*Theropithecus gelada*	Northern Ethiopia	Entire	T	16	NA	17 40(c)
Gibbons	*Hylobates* spp. (including *Nomascus*).	China, India, southeastern Asia	Entire	E	3, 15	NA	NA
Goral	*Nemorhaedus goral*	East Asia	Entire	E	15	NA	NA
Gorilla	*Gorilla gorilla*	Central and Western Africa	Entire	E	3	NA	NA
Hare, hispid	*Caprolagus hispidus*	India, Nepal	Entire	E	15	NA	NA
Hartebeest, Swayne's	*Alcelaphus buselaphus swaynei*	Ethiopia, Somalia	Entire	E	3, 50	NA	NA
Hartebeest, Tora	*Alcelaphus buselaphus tora*	Ethiopia, Sudan, Egypt	Entire	E	50	NA	NA
Hog, pigmy	*Sus salvanius*	India, Nepal, Bhutan, Sikkim	Entire	E	3	NA	NA
Horse, Przewalski's	*Equus przewalskii*	Mongolia	Entire	E	15	NA	NA
Huemul, North Andean	*Hippocamelus antisensis*	Ecuador, Peru, Chile, Bolivia, Argentina.	Entire	E	15	NA	NA
Huemul, South Andean	*Hippocamelus bisulcus*	Chile, Argentina	Entire	E	15	NA	NA
Hyena, Barbary	*Hyaena hyaena barbara*	Morocco	Entire	E	3	NA	NA
Hyena, brown	*Hyaena brunnea*	Southern Africa	Entire	E	3	NA	NA
Ibex, Pyrenean	*Capra pyrenaica pyrenaica*	Spain	Entire	E	3	NA	NA
Ibex, Walia	*Capra walie*	Ethiopia	Entire	E	3	NA	NA
Impala, black-faced	*Aepyceros melampus petersi*	Southwest Africa, Namibia, Angola.	Entire	E	3	NA	NA
Indris	*Indris* spp. (all species)	Malagasy Republic (=Madagascar) Comoro Island.	Entire	E	3	NA	NA
Jaguar	*Panthera onca*	U.S.A. (TX, NM, AZ), Central and South America.	Mexico southward.	E	5	NA	NA
Jaguarundi	*Felis yagouaroundi cacomitli*	U.S.A. (TX), Mexico	Entire	E	15	NA	NA
Jaguarundi	*Felis yagouaroundi fossata*	Mexico, Nicaragua	Entire	E	15	NA	NA
Jaguarundi	*Felis yagouaroundi panamensis*	Nicaragua, Costa Rica, Panama	Entire	E	15	NA	NA
Jaguarundi	*Felis yagouaroundi tolteca*	U.S.A. (AZ), Mexico	Entire	E	15	NA	NA
Kangaroo, eastern gray (see also Forester, Tasmanian).	*Macropus giganteus* (all subspecies except *tasmaniensis*).	Australia	Entire	T	7	NA	17 40(a)
Kangaroo, red	*Megaleia rufa*	Australia	Entire	T	7	NA	17.40(a)
Kangaroo, western gray	*Macropus fuliginosus*	Australia	Entire	T	7	NA	17.40(a)
Kouprey	*Bos sauveli*	Vietnam, Laos, Cambodia, Thailand.	Entire	E	3	NA	NA
Langur, capped	*Presbytis pileatus*	India, Burma	Entire	E	15	NA	NA
Langur, entellus	*Presbytis entellus*	China (Tibet), India, Pakistan, Kashmir, Sri Lanka, Sikkim, Bangladesh.	Entire	E	15	NA	NA
Langur, Douc	*Pygathrix nemaeus*	Cambodia, Laos, China, Vietnam	Entire	E	3	NA	NA
Langur, golden	*Presbytis geei*	India (Assam), Bhutan	Entire	E	15	NA	NA
Langur, long-tailed	*Presbytis potenziani*	Indonesia	Entire	T	16	NA	17 40(c)
Langur, Pagi Island	*Simias concolor*	Indonesia	Entire	E	3	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Langur, purple-faced	*Presbytis senex*	Sri Lanka (= Ceylon)	Entire	T	16	NA	17.40(c)
Lechwe, red	*Kobus leche*	Southern Africa	Entire	E	3, 16	NA	NA
Lemurs	*Lemuridae* (incl. Cheirogaleidae, Lepilemuridae); all members of genera *Lemur, Phaner, Hapalemur, Lepilemur, Microcebus, Allocebus, Cheirogaleus, Varecia.*	Malagasy Republic (= Madagascar).	Entire	E	3, 16	NA	NA
Leopard	*Panthera pardus*	Africa, India, Southeast Asia	Entire	E	3, 5	NA	NA
Leopard, clouded	*Neofelis nebulosa*	Southeast and South-central Asia, Taiwan.	Entire	E	3, 15	NA	NA
Leopard, snow	*Panthera uncia*	Central Asia	Entire	E	5	NA	NA
Linsang, spotted	*Prionodon pardicolor*	Nepal, Assam, Vietnam, Cambodia, Laos, Burma.	Entire	E	16	NA	NA
Lion, Asiatic	*Panthera leo persica*	Western Iran to India	Entire	E	3	NA	NA
Loris, lesser slow	*Nycticebus pygmaeus*	Indochina	Entire	T	16	NA	17.40(c)
Lynx, Spanish	*Felis lynx pardina*	Spain	Entire	E	3	NA	NA
Macaque, Formosan rock	*Macaca cyclopis*	Taiwan	Entire	T	16	NA	17.40(c)
Macaque, Japanese	*Macaca fuscata*	Japan (Shikoku, Kyushu and Honshu Islands).	Entire	T	16	NA	17.40(c)
Macaque, lion-tailed	*Macaca silenus*	India	Entire	E	3	NA	NA
Macaque, stump-tailed	*Macaca arctoides*	India (Assam) to southern China	Entire	T	16	NA	17.40(c)
Macaque, Toque	*Macaca sinica*	Sri Lanka (= Ceylon)	Entire	T	16	NA	17.40(c)
Manatee, Amazonian	*Trichechus inunguis*	South America; Amazon River Basin.	Entire	E	3	NA	NA
Manatee, West African	*Trichechus senegalensis*	West Coast of Africa from Senegal River Cuanza River.	Entire	T	62	NA	NA
Manatee, West Indian (Florida)	*Trichechus manatus*	U.S.A. (southeastern), Caribbean Ocean, South America.	Entire	E	1, 3	17.95(a)	NA
Mandrill	*Papio sphinx*	Equatorial West Africa	Entire	E	16	NA	NA
Mangabey, Tana River	*Cercocebus galeritus*	Kenya	Entire	E	3	NA	NA
Mangabey, white-collared	*Cercocebus torquatus*	Senegal to Ghana; Nigeria to Gabon.	Entire	E	16	NA	NA
Margay	*Felis wiedii*	U.S.A. (NM, AZ), Central and South America.	Mexico southward.	E	5	NA	NA
Markhor, Chiltan	*Capra falconeri chiltanensis*	Pakistan	Entire	E	15	NA	NA
Markhor, Kabal	*Capra falconeri megaceros*	Afghanistan, Pakistan	Entire	E	15	NA	NA
Markhor, straight-horned	*Capra flaconeri jerdoni*	Pakistan, Afghanistan	Entire	E	15	NA	NA
Marmoset, cotton-top	*Saguinus oedipus*	Panama, Costa Rica, Colombia	Entire	E	16	NA	NA
Marmoset, Goeldi's	*Callimico goeldii*	Brazil, Colombia, Ecuador, Peru	Entire	E	3	NA	NA
Marsupial, eastern jerboa	*Antechinomys laniger*	Australia	Entire	E	4	NA	NA
Marsupial-mouse large desert	*Sminthopsis psammophila*	Australia	Entire	E	4	NA	NA
Marsupial-mouse, long-tailed	*Sminthopsis longicaudata*	Australia	Entire	E	4	NA	NA
Marten, Formosan yellow-throated	*Martes flavigula chrysospila*	Taiwan	Entire	E	3	NA	NA
Monkey, black howler	*Alouatta pigra*	Mexico, Guatemala, Belize	Entire	T	16	NA	17.40(c)
Monkey Diana	*Cercopithecus diana*	Coastal West Africa	Entire	E	16	NA	NA
Monkey, Francois' leaf	*Presbytis francoisi*	China (Kwangsi), Indochina	Entire	E	16	NA	NA
Monkey, howler	*Alouatta villosa*	Mexico to South America	Entire	E	16	NA	NA
Monkey, L'hoest's	*Cercopithecus lhoesti*	Upper Eastern Congo Basin, Cameroon.	Entire	E	16	NA	NA
Monkey, proboscis	*Nasalis larvatus*	Borneo	Entire	E	16	NA	NA
Monkey, red-backed squirrel	*Saimiri oerstedii*	Costa Rica, Panama	Entire	E	3	NA	NA
Monkey, red-bellied	*Cercopithecus erythrogaster*	Western Nigeria	Entire	E	16	NA	NA
Monkey, red-eared nose-spotted	*Cercopithecus erythrotis*	Nigeria, Cameroon, Fernando Po	Entire	E	16	NA	NA
Monkey, spider	*Ateles geoffroyi frontatus*	Costa Rica, Nicaragua	Entire	E	3	NA	NA
Monkey, spider	*Ateles geoffroyi panamensis*	Costa Rica, Panama	Entire	E	3	NA	NA
Monkey, Tonkin snub-nosed	*Rhinopithecus avunculus*	Vietnam	Entire	T	16	NA	17.40(c)
Monkey, woolly spider	*Brachyteles arachnoides*	Brazil	Entire	E	3	NA	NA
Monkey, yellow-tailed woolly	*Lagothrix flavicauda*	Andes of northern Peru	Entire	E	16	NA	NA
Mouse, Australian native	*Notomys pedunculatus*	Australia	Entire	E	15	NA	NA
Mouse, Australian native	*Notomys aquilo*	Australia	Entire	E	15	NA	NA
Mouse, Field's	*Pseudomys fieldi*	Australia	Entire	E	4	NA	NA
Mouse, Gould's	*Pseudomys gouldii*	Australia	Entire	E	6	NA	NA
Mouse, New Holland	*Pseudomys novaehollandiae*	Australia	Entire	E	4	NA	NA
Mouse, salt marsh harvest	*Reithrodontomys raviventris*	U.S.A. (California)	Entire	E	2	NA	NA
Mouse, Shark Bay	*Pseudomys praeconis*	Australia	Entire	E	4	NA	NA
Mouse, Shortridge's	*Pseudomys shortridgei*	Australia	Entire	E	4	NA	NA
Mouse, Smoky	*Pseudomys fumeus*	Australia	Entire	E	4	NA	NA
Mouse, western	*Pseudomys occidentalis*	Australia	Entire	E	4	NA	NA
Muntjac, Fea's	*Muntiacus feae*	Northern Thailand, Burma	Entire	E	60	NA	NA
Native-cat, eastern	*Dasyurus viverrinus*	Australia	Entire	E	6	NA	NA
Numbat	*Myrmecobius fasciatus*	Australia	Entire	E	4, 6	NA	NA
Ocelot	*Felis pardalis*	Southwest U.S.A., Central and South America.	Mexico southward.	E	5	NA	NA
Orangutan	*Pongo pygmaeus*	Borneo, Sumatra	Entire	E	3	NA	NA
Oryx, Arabian	*Oryx leucoryx*	Arabian Peninsula	Entire	E	3	NA	NA
Otter, Cameroon clawless	*Paraonyx microdon*	Cameroon	Entire	E	3	NA	NA
Otter, giant	*Pteronura brasiliensis*	South America	Entire	E	3	NA	NA
Otter, La Plata	*Lutra platensis*	Argentina, Bolivia, Uruguay, Brazil	Entire	E	3	NA	NA
Otter, long-tailed	*Lutra longicaudis*	South America	Entire	E	16	NA	NA
Otter, marine	*Lutra felina*	Peru, south to Straits of Magellan	Entire	E	15	NA	NA
Otter, southern river	*Lutra provocax*	Chile, Argentina	Entire	E	16	NA	NA
Otter, southern sea	*Enhydra lutris nereis*	West coast U.S.A. (WA) south to Mexico (Baja California).	Entire	T	21	NA	NA
Panther, Florida	*Felis concolor coryi*	U.S.A. (LA and AR east to SC and FL).	Entire	E	1	NA	NA
Planigale, little	*Planigale subtilissima*	Australia	Entire	E	4	NA	NA
Planigale, southern	*Planigale tenuirostris*	Australia	Entire	E	4	NA	NA
Porcupine, thin-spined	*Chaetomys subspinosus*	Brazil	Entire	E	3	NA	NA

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Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Possum, mountain pigmy	*Burramys parvus*	Australia	Entire	E	4	NA	NA
Possum, scaly-tailed	*Wyulda squamicaudata*	Australia	Entire	E	4	NA	NA
Prairie dog, Mexican	*Cynomys mexicanus*	Mexico	Entire	E	3	NA	NA
Prairie dog, Utah	*Cynomys parvidens*	U.S.A. (Utah)	Entire	E	6	NA	NA
Pronghorn, peninsular	*Antilocapra americana peninsularis.*	Mexico (Baja California)	Entire	E	10	NA	NA
Pronghorn, Sonoran	*Antilocapra americana sonoriensis.*	U.S.A. (AZ), Mexico	Entire	E	1, 3	NA	NA
Pudu	*Pudu pudu*	Southern South America	Entire	E	15	NA	NA
Puma, Costa Rican	*Felis concolor costaricensis*	Nicaragua, Panama, Costa Rica	Entire	E	15	NA	NA
Quokka	*Setonix brachyurus*	Australia	Entire	E	6	NA	NA
Rabbit, Ryukyu	*Pentalagus furnessi*	Japan (Ryukyu Island)	Entire	E	80	NA	NA
Rabbit, volcano	*Romerolagus diazi*	Mexico	Entire	E	3	NA	NA
Rat, false water	*Xeromys myoides*	Australia	Entire	E	4	NA	NA
Rat, stick-nest	*Leporillus conditor*	Australia	Entire	E	6	NA	NA
Rat, Morro Bay kangaroo	*Dipodomys heermanni*	U.S.A. (California)	Entire	E	2	17.95(a)	NA
Rat—kangaroo, brush-tailed	*Bettongia penicillata*	Australia	Entire	E	4	NA	NA
Rat—kangaroo, Gaimard's	*Bettongia gaimardi*	Australia	Entire	E	4	NA	NA
Rat—kangaroo, Lesuer's	*Bettongia lesueur*	Australia	Entire	E	6	NA	NA
Rat—kangaroo, plain	*Caloprymnus campestris*	Australia	Entire	E	4	NA	NA
Rat—kangaroo, Queensland	*Bettongia tropica*	Australia	Entire	E	4	NA	NA
Rhinoceros, great Indian	*Rhinoceros unicornis*	India, Nepal	Entire	E	4	NA	NA
Rhinoceros, Javan	*Rhinoceros sondaicus*	Indonesia, Indochina, Burma.	Entire	E	3	NA	NA
Rhinoceros, northern white	*Ceratotherium simum cottoni*	Zaire, Sudan, Uganda, Central African Republic.	Entire	E	3	NA	NA
Rhinoceros, Sumatran	*Didermoceros sumatrensis*	Bangladesh to Vietnam to Indonesia (Borneo).	Entire	E	3	NA	NA
Saki, white-nosed	*Chiropotes albinasus*	Brazil	Entire	E	3	NA	NA
Seal, Caribbean monk	*Monachus tropicalis*	Caribbean Sea, Gulf of Mexico	Entire	E	1, 20, 46	NA	NA
Seal, Hawaiian monk	*Monachus schauinslandi*	Hawaiian Archipelago	Entire	E	18	NA	NA
Seal, Mediterranean monk	*Monachus monachus*	Mediterranean, Northwest African Coast and Black Sea.	Entire	E	3	NA	NA
Seladang (=Guar)	*Bos gaurus*	Bangladesh, Southeast Asia, India.	Entire	E	3	NA	NA
Serow, Sumatran	*Capricornis sumatraensis*	Sumatra	Entire	E	15	NA	NA
Serval, Barbery	*Felis serval constantina*	Algeria	Entire	E	3	NA	NA
Shapo	*Ovis vignei*	Kashmir	Entire	E	15	NA	NA
Shou	*Cervus elaphus wallichi*	Tibet, Bhutan	Entire	E	7	NA	NA
Siamang	*Symphalangus syndactylus*	Malaysia, Indonesia	Entire	E	15	NA	NA
Sifakas	*Propithecus* spp. (all species)	Malagasy Republic (=Madagascar).	Entire	E	4	NA	NA
Sika (deer), Formosan	*Cervus nippon taiouanus*	Taiwan	Entire	E	80	NA	NA
Sika (deer), North China	*Cervus nippon mandarinus*	China (Shantung and Chihli Provinces).	Entire	E	80	NA	NA
Sika (deer), Ryukyu	*Cervus nippon keramae*	Japan (Ryukyu Island)	Entire	E	80	NA	NA
Sika (deer), Shansi	*Cervus nippon grassianus*	China (Shansi Province)	Entire	E	80	NA	NA
Sika (deer), South China	*Cervus nippon kopschi*	Southern China	Entire	E	80	NA	NA
Sloth, Brazilian three-toed	*Bradypus torquatus*	Brazil	Entire	E	3, 4	NA	NA
Solenodon, Cuban	*Atopogale cubana*	Cuba	Entire	E	3	NA	NA
Solenodon, Haitian	*Solenodon paradoxus*	Dominican Republic, Haiti	Entire	E	3	NA	NA
Squirrel, Delmarva Peninsula fox	*Sciurus niger cinereus*	U.S.A. (DelMarVa Peninsula to Southeast PA).	Entire	E	1	NA	NA
Stag, Barbary	*Cervus elaphus barbarus*	Tunisia, Algeria	Entire	E	3	NA	NA
Stag, Kashmir	*Cervus elaphus hanglu*	Kashmir	Entire	E	3	NA	NA
Suni, Zanzibar	*Neotragus moschatus moschatus.*	Zanzibar (and neighboring states)	Entire	E	80	NA	NA
Tahr, Arabian	*Hemitragus jayakari*	Oman	Entire	E	80	NA	NA
Tamaraw	*Bubalus mindorensis*	Philippines	Entire	E	4	NA	NA
Tamarin, golden-rumped (=golden-headed Tamarin; =golden-lion Marmoset).	*Leontideus* spp. (all species)	Brazil	Entire	E	3	NA	NA
Tamarin, pied	*Saguinus bicolor*	Northern Brazil	Entire	E	16	NA	NA
Tamarin, white-footed	*Saguinus leucopus*	Northern Colombia	Entire	T	16	NA	17.40(c)
Tapir, Asian	*Tapirus indicus*	Burma, Laos, Cambodia, Vietnam, Malaysia, Indonesia, Thailand.	Entire	E	15	NA	NA
Tapir, Brazilian	*Tapirus terrestris*	Colombia and Venezuela south to Paraguay and Argentina.	Entire	E	3	NA	NA
Tapir, Central American	*Tapirus bairdii*	Southern Mexico to Colombia and Ecuador.	Entire	E	3	NA	NA
Tapir, mountain	*Tapirus pinchaque*	Colombia, Ecuador and possibly Peru and Venezuela.	Entire	E	3	NA	NA
Tarsier, Philippine	*Tarsius syrichta*	Philippines	Entire	T	16	NA	17.40(c)
Tiger	*Panthera tigris*	Temperate and Tropical Asia	Entire	E	3, 5	NA	NA
Tiger, Tasmanian (=Thylacine)	*Thylacinus cynocephalus*	Australia	Entire	E	3	NA	NA
Uakari (all species)	*Cacajao* spp. (all species)	Peru, Brazil, Ecuador, Columbia, Venezuela.	Entire	E	3	NA	NA
Urial	*Ovis orientalis ophion*	Cyprus	Entire	E	15	NA	NA
Vicuna	*Vicugna vicugna*	South American Andes	Entire	E	3	NA	NA
Wallaby, banded hare	*Lagostrophus fasciatus*	Australia	Entire	E	4	NA	NA
Wallaby, brindled nail-tailed	*Onychogalea frenata*	Australia	Entire	E	4	NA	NA
Wallaby, crescent nail-tailed	*Onychogalea lunata*	Australia	Entire	E	4	NA	NA
Wallaby, Parma	*Macropus parma*	Australia	Entire	E	4	NA	NA
Wallaby, Western hare	*Lagorchestes hirsutus*	Australia	Entire	E	4	NA	NA
Wallaby, yellow-footed rock	*Petrogale xanthopus*	Australia	Entire	E	6	NA	NA
Whale, blue	*Balaenoptera musculus*	Oceanic	Entire	E	3	NA	NA
Whale, bowhead	*Balaena mysticetus*	Oceanic (north latitudes only)	Entire	E	3	NA	NA
Whale, finback	*Balaenoptera physalus*	Oceanic	Entire	E	3	NA	NA

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Common name	Scientific name						
Whale, gray	*Eschrichtius robustus*	North Pacific Ocean: coastal and Bering Sea.	Entire	E	3	NA	NA
Whale, humpback	*Megaptera novaeangliae*	Oceanic	Entire	E	3	NA	NA
Whale, right	*Balaena glacialis*	Oceanic	Entire	E	3	NA	NA
Whale, Sei	*Balaenoptera borealis*	Oceanic	Entire	E	3	NA	NA
Whale, sperm	*Physeter catodon*	Oceanic	Entire	E	3	NA	NA
Wolf, gray	*Canis lupus*	Holarctic	U.S.A. (48 conterminous States other than MN), Mexico.	E	1, 6, 13, 15, 35	17.95(a)	NA
Wolf, gray	*Canis lupus*	Holarctic	U.S.A. (MN)	T	35	17.95(a)	17.40(d)
Wolf, maned	*Chrysocyon brachyurus*	Argentina, Bolivia, Brazil, Paraguay, Uruguay.	Entire	E	4	NA	NA
Wolf, red	*Canis rufus*	U.S.A. (southeast U.S.A. west to central TX).	Entire	E	1	NA	NA
Wombat, Barnard's	*Lasiorhinus barnardi*	Australia	Entire	E	4	NA	NA
Wombat, Queensland hairy-nosed	*Lasiorhinus gillespiei*	Australia	Entire	E	6	NA	NA
Yak, wild	*Bos grunniens mutus*	China (Tibet), India	Entire	E	3	NA	NA
Zebra, Grevy's	*Equus grevyi*	Kenya, Ethiopia, Sudan	Entire	T	54	NA	NA
Zebra, mountain	*Equus zebra*	South Africa	Entire	E	15, 54	NA	NA
BIRDS							
Akepa, Hawaii (honeycreeper)	*Loxops coccinea coccinea*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Akepa, Maui (honeycreeper)	*Loxops coccinea ochracea*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Akialoa, Kauai (honeycreeper)	*Hemignathus procerus*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Akiapolaau (honeycreeper)	*Hemignathus wilsoni*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Albatross, short-tailed	*Diomedea albatrus*	North Pacific Ocean: Japan, U.S.S.R., U.S.A. (AK, CA, HA, OR, WA).	Entire, except U.S.A.	E	3	NA	NA
Blackbird, yellow-shouldered	*Agelaius xanthomus*	U.S.A. (Puerto Rico)	Entire	E	17	17.95(b)	NA
Bobwhite, masked (quail)	*Colinus virginianus ridgwayi*	U.S.A. (Arizona), Mexico (Sonora)	Entire	E	1, 3	NA	NA
Booby, Abbott's	*Sula abbotti*	Indian Ocean: Christmas Island	Entire	E	15	NA	NA
Bristlebird, western	*Dasyornis brachypterus longirostris*	Australia	Entire	E	3	NA	NA
Bristlebird, western rufous	*Dasyornis broadbenti litoralis*	Australia	Entire	E	15	NA	NA
Bulbul, Mauritius olivaceous	*Hypsipetes borbonicus olivaceus*	Mauritius	Entire	E	3	NA	NA
Bullfinch, Sao Miguel (finch)	*Pyrrhula pyrrhula murina*	Eastern Atlantic Ocean: Azores	Entire	E	3	NA	NA
Bushwren, New Zealand	*Xenicus longipes*	New Zealand	Entire	E	3	NA	NA
Bustard, great Indian	*Choriotis nigriceps*	India, Pakistan	Entire	E	3	NA	NA
Cahow (=Bermuda Petrel)	*Pterodroma cahow*	North Atlantic Ocean: Bermuda	Entire	E	3	NA	NA
Condor, Andean	*Vultur gryphus*	Colombia to Chile and Argentina	Entire	E	4	NA	NA
Condor, California	*Gymnogyps californianus*	U.S.A. (OR, CA), Mexico (Baja California).	Entire	E	1	17.95(b)	NA
Coot, Hawaiian	*Fulica americana alai*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Cotinga, banded	*Cotinga maculata*	Brazil	Entire	E	15	NA	NA
Cotinga, white-winged	*Xipholena atropurpurea*	Brazil	Entire	E	15	NA	NA
Crane, black-necked	*Grus nigricollis*	China (Tibet)	Entire	E	15	NA	NA
Crane, Cuba sandhill	*Grus canadensis nesiotes*	West Indies: Cuba	Entire	E	15	NA	NA
Crane, hooded	*Grus monacha*	Japan, U.S.S.R.	Entire	E	4	NA	NA
Crane, Japanese	*Grus japonensis*	China, Japan, Korea, U.S.S.R.	Entire	E	3	NA	NA
Crane, Mississippi sandhill	*Grus canadensis pulla*	U.S.A. (Mississippi)	Entire	E	6	(17.95(b)	NA
Crane, Siberian white	*Grus leucogeranus*	U.S.S.R. (Siberia) to India, including Iran and China.	Entire	E	4	NA	NA
Crane, white-naped	*Grus vipio*	Mongolia	Entire	E	15	NA	NA
Crane, whooping	*Grus americana*	Canada, U.S.A. (Rocky Mountains east to Carolinas), Mexico.	Entire	E	1, 3	17.95(b)	NA
Creeper, Hawaiian	*Loxops maculata mana*	U.S.A. (Hawaii)	Entire	E	10	NA	NA
Creeper, Molokai (=Kakawahie)	*Loxops maculata flammea*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Creeper, Oahu (=alauwahio)	*Loxops maculata maculata*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Crow, Hawaiian (=alala)	*Corvus tropicus*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Cuckoo-shrike, Mauritius	*Coquus (=Coracina) typicus*	Indian Ocean: Mauritius	Entire	E	3	NA	NA
Cuckoo-shrike, Reunion	*Coquus (=Coracina) newtoni*	Indian Ocean: Reunion	Entire	E	3	NA	NA
Curassow, razor-billed	*Mitu (=Crax) mitu mitu*	Brazil (Eastern)	Entire	E	15	NA	NA
Curassow, red-billed	*Crax blumenbachii*	Brazil	Entire	E	4	NA	NA
Curassow, Trinidad, white-headed	*Pipile pipile pipile*	West Indies: Trinidad	Entire	E	3	NA	NA
Curlew, Eskimo	*Numenius borealis*	Alaska and northern Canada to Argentina.	Entire	E	1, 3	NA	NA
Dove, cloven-feathered	*Drepanoptila holosericea*	Southwest Pacific Ocean: New Caledonia.	Entire	E	3	NA	NA
Dove, Grenada	*Leptotila wellsi*	West Indies: Grenada	Entire	E	3	NA	NA
Dove, Palau ground	*Gallicolumba canifrons*	West Pacific Ocean: U.S.A. (Palau Islands).	Entire	E	3	NA	NA
Duck, Hawaiian (=koloa)	*Anas wyvilliana*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Duck, Laysan	*Anas laysanensis*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Duck, pink-headed	*Rhodonessa caryophyllacea*	India	Entire	E	15	NA	NA
Duck, white-winged wood	*Cairina scutulata*	India, Malaysia, Indonesia, Thailand.	Entire	E	3	NA	NA
Eagle, Greenland white-tailed	*Haliaeetus albicilla groenlandicus*	Greenland and adjacent Atlantic islands.	Entire	E	15	NA	NA
Eagle, harpy	*Harpia harpyja*	Mexico south to Argentina	Entire	E	15	NA	NA
Eagle, Philippine (=monkey-eating)	*Pithecophaga jefferyi*	Philippines	Entire	E	3	NA	NA
Eagle, bald	*Haliaeetus leucocephalus*	North America south to northern Mexico.	U.S.A. (conterminous States, except WA, OR, MN, WI, MI).	E	1, 34	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Eagle, bald	*Haliaeetus leucocephalus*	North America south to northern Mexico.	U.S.A. (WA, OR, MN, WI, MI).	T	34	NA	17.41(a)
Eagle, Spanish imperial	*Aquila heliaca adalberti*	Spain, Morocco, Algeria	Entire	E	3	NA	NA
Egret, Chinese	*Egretta eulophotes*	China, Korea	Entire	E	3	NA	NA
Falcon, American peregrine	*Falco peregrinus anatum*	Canada, U.S.A., Mexico	Entire	E	2, 3	17.95(c)	NA
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	Alaska to Greenland, south to Argentina.	Entire	E	2, 3	NA	NA
Falcon, Eurasian peregrine	*Falco peregrinus peregrinus*	Europe, Eurasia south to Africa and Mideast.	Entire	E	15	NA	NA
Finch, Laysan (honeycreeper)	*Telespyza* (= *Psittirostra*) *cantans*.	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Finch, Nihoa (honeycreeper)	*Telespyza* (= *Psittirostra*) *ultima*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Flycatcher, Euler's	*Empidonax euleri johnstonei*	West Indies: Grenada	Entire	E	3	NA	NA
Flycatcher, Palau fantail	*Rhipidura lepida*	West Pacific Ocean: U.S.A. (Palau Islands).	Entire	E	3	NA	NA
Flycatcher, Seychelles paradise	*Terpsiphone corvina*	Indian Ocean: Seychelles	Entire	E	3	NA	NA
Flycatcher, Tahiti	*Pomarea nigra*	South Pacific Ocean: Tahiti	Entire	E	3	NA	NA
Flycatcher, Tinian monarch	*Monarcha takatsukasae*	Western Pacific Ocean: U.S.A. (Mariana Islands).	Entire	E	3	NA	NA
Fody, Seychelles (weaver-finch)	*Foudia sechellarum*	Indian Ocean: Seychelles	Entire	E	3	NA	NA
Frigatebird, Andrew's	*Fregata andrewsi*	East Indian Ocean	Entire	E	15	NA	NA
Gallinule, Hawaiian	*Gallinula chloropus sandvicensis*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Goose, Aleutian Canada	*Branta canadensis leucopareia*	Western U.S.A. (AK, CA, OR, WA), Japan.	Entire	E	1, 3	NA	NA
Goose, Hawaiian (= Nene)	*Branta sandvicensis*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Goshawk, Christmas Island	*Accipiter fasciatus natalis*	Indian Ocean: Christmas Island	Entire	E	3	NA	NA
Grackle, slender-billed	*Cassidix palustris*	Mexico	Entire	E	3	NA	NA
Grasswren, Eyrean (flycatcher)	*Amytornis goyderi*	Australia	Entire	E	3	NA	NA
Grebe, Atitlan	*Podilymbus gigas*	Guatemala	Entire	E	3	NA	NA
Greenshank, Nordmann's	*Tringa guttifer*	U.S.S.R., Japan, south to Malaya, Borneo.	Entire	E	15	NA	NA
Guan, horned	*Oreophasis derbianus*	Guatemala, Mexico	Entire	E	3	NA	NA
Gull, Audouin's	*Larus audouinii*	Mediterranean Sea	Entire	E	3	NA	NA
Gull, relict	*Larus relictus*	India, China	Entire	E	15	NA	NA
Hawk, Anjouan Island sparrow	*Accipiter francesii pusillus*	Indian Ocean: Comoro Islands	Entire	E	3	NA	NA
Hawk, Galapagos	*Buteo galapagoensis*	Ecuador (Galapagos Island)	Entire	E	3	NA	NA
Hawk, Hawaiian (= Io)	*Buteo solitarius*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Hermit, hook-billed (hummingbird)	*Glaucis* (= *Ramphodon*) *dohrnii*	Brazil	Entire	E	15	NA	NA
Honeycreeper, crested (= akohekohe).	*Palmeria dolei*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Hornbill, helmeted	*Rhinoplax vigil*	Thailand, Malaysia	Entire	E	15	NA	NA
Ibis, Japanese crested	*Nipponia nippon*	China, Japan, U.S.S.R., Korea	Entire	E	3	NA	NA
Kagu	*Rhynochetos jubatus*	Southwestern Pacific Ocean: New Caledonia.	Entire	E	3	NA	NA
Kakapo (= owl-parrot)	*Strigops habroptilus*	New Zealand	Entire	E	3	NA	NA
Kestrel, Mauritius	*Falco punctatus*	Indian Ocean: Mauritius	Entire	E	3	NA	NA
Kestrel, Seychelles	*Falco araea*	Indian Ocean: Seychelles Islands	Entire	E	3	NA	NA
Kite, Cuba hook-billed	*Chondrohierax uncinatus wilsonii*	West Indies: Cuba	Entire	E	3	NA	NA
Kite, Grenada hook-billed	*Chondrohierax uncinatus mirus*	West Indies: Grenada	Entire	E	3	NA	NA
Kite, Everglade (snail kite)	*Rostrhamus sociabilis plumbeus*	U.S.A. (Florida)	Entire	E	1	17.95(b)	NA
Kokako (wattlebird)	*Callaeas cinerea*	New Zealand	Entire	E	3	NA	NA
Macaw, glaucous	*Anodorhynchus glaucus*	Paraguay, Uruguay, Brazil	Entire	E	15	NA	NA
Macaw, indigo	*Anodorhynchus leari*	Brazil	Entire	E	15	NA	NA
Macaw, little blue	*Cyanopsitta spixii*	Brazil	Entire	E	15	NA	NA
Magpie-robin, Seychelles (thrush)	*Copsychus sechellarum*	Indian Ocean: Seychelles Islands	Entire	E	3	NA	NA
Malkoha, red-faced (cuckoo)	*Phaenicophaeus pyrrhocephalus*	Sri Lanka (= Ceylon)	Entire	E	3	NA	NA
Mallard, Mariana	*Anas oustaleti*	West Pacific Ocean: (Guam, Mariana Island).	Entire	E	23	NA	NA
Megapode, La Perouse's	*Megapodius laperouse*	West Pacific Ocean: U.S.A. (Palau Island, Mariana Island).	Entire	E	3	NA	NA
Megapode, Maleo	*Macrocephalon maleo*	Indonesia (Celebes)	Entire	E	3	NA	NA
Millerbird, Nihoa (willow warbler)	*Acrocephalus familiaris kingi*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Nukupuu (honeycreeper)	*Hemignathus lucidus*	U.S.A. (Hawaii)	Entire	E	1, 2	NA	NA
Oo, Kauai (= Oo Aa) (honeyeater)	*Moho braccatus*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Ostrich, Arabian	*Struthio camelus syriacus*	Jordan, Saudi Arabia	Entire	E	3	NA	NA
Ostrich, West African	*Struthio camelus spatzi*	Spanish Sahara	Entire	E	3	NA	NA
Ou (honeycreeper)	*Psittirostra psittacea*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Owl, Anjouan scops	*Otus rutilus capnodes*	Indian Ocean: Comoro Island	Entire	E	3	NA	NA
Owl, giant scops	*Otus gurneyi*	Philippines: Marinduque and Mindanao Island.	Entire	E	15	NA	NA
Owl, Palau	*Otus podargina*	West Pacific Ocean: U.S.A. (Palau Islands).	Entire	E	3	NA	NA
Owl, Seychelles	*Otus insularis*	Indian Ocean: Seychelles Island	Entire	E	3	NA	NA
Owlet, Mr. Morden's	*Otus ireneae*	Kenya	Entire	E	3	NA	NA
Palila (honeycreeper)	*Psittirostra bailleui*	U.S.A. (Hawaii)	Entire	E	1	17.95(b)	NA
Parakeet, Forbes'	*Cyanoramphus auriceps forbesi*	New Zealand	Entire	E	3, 15	NA	NA
Parakeet, golden	*Aratinga guarouba*	Brazil	Entire	E	4	NA	NA
Parakeet, golden-shouldered (= hooded)	*Psephotus chrysopterygius*	Australia	Entire	E	3	NA	NA
Parakeet, Mauritius	*Psittacula echo*	Indian Ocean: Mauritius	Entire	E	3	NA	NA
Parakeet, ochre-marked	*Pyrrhura cruentata*	Brazil	Entire	E	3	NA	NA
Parakeet, orange-bellied	*Neophema chrysogaster*	Australia	Entire	E	4	NA	NA
Parakeet, paradise	*Psephotus pulcherrimus*	Australia	Entire	E	4	NA	NA
Parakeet, scarlet-chested	*Neophema splendida*	Australia	Entire	E	4	NA	NA
Parakeet, turquoise night	*Neophema pulchella*	Australia	Entire	E	3	NA	NA
Parrot, Australian	*Geopsittacus occidentalis*	Australia	Entire	E	3	NA	NA
Parrot, Bahaman or Cuban	*Amazona leucocephala*	West Indies: Cuba, Bahamas, Caymans.	Entire	E	3, 15	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Parrot, ground	*Pezoporus wallicus*	Australia	Entire	E	6	NA	NA
Parrot, imperial	*Amazona imperialis*	West Indies: Dominica	Entire	E	3	NA	NA
Parrot, Puerto Rican	*Amazona vittata*	U.S.A. (Puerto Rico)	Entire	E	1	NA	NA
Parrot, red-browed	*Amazona rhodocorytha*	Brazil	Entire	E	3	NA	NA
Parrot, red-capped	*Pionopsitta pileata*	Brazil	Entire	E	15	NA	NA
Parrot, red-necked	*Amazona arausiaca*	West Indies: Dominica	Entire	E	50	NA	NA
Parrot, red-spectacled	*Amazona pretrei pretrei*	Brazil, Argentina	Entire	E	15	NA	NA
Parrot, St. Lucia	*Amazona versicolor*	West Indies: St. Lucia	Entire	E	3	NA	NA
Parrot, St. Vincent	*Amazona guildingii*	West Indies: St. Vincent	Entire	E	3	NA	NA
Parrot, thick-billed	*Rhynchopsitta pachyrhyncha*	Mexico, U.S.A. (AZ, NM)	Mexico	E	3	NA	NA
Parrot, vinaceous-breasted	*Amazona vinacea*	Brazil	Entire	E	15	NA	NA
Parrotbill, Maui (honeycreeper)	*Pseudonestor xanthophrys*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Pelican, brown	*Pelecanus occidentalis*	U.S.A. (Carolinas to Texas, CA), West Indies, Central and South America: Coastal	Entire	E	2, 3	NA	NA
Penguin, Galapagos	*Spheniscus mendiculus*	Ecuador (Galapagos Island)	Entire	E	3	NA	NA
Petrel, Hawaiian dark-rumped	*Pterodroma phaeopygia sandwichensis*	U.S.A. (Hawaii)	Entire	E	2, 4, 1	NA	NA
Pheasant, bar-tailed	*Syrmaticus humiae*	Burma, China	Entire	E	3	NA	NA
Pheasant, Blyth's tragopan	*Tragopan blythii*	Burma, China, India	Entire	E	3	NA	NA
Pheasant, brown eared	*Crossoptilon mantchuricum*	China	Entire	E	3	NA	NA
Pheasant, Cabot's tragopan	*Tragopan caboti*	China	Entire	E	3	NA	NA
Pheasant, Chinese monal	*Lophophorus lhuysii*	China	Entire	E	3	NA	NA
Pheasant, Edward's	*Lophura edwardsi*	Vietnam	Entire	E	3	NA	NA
Pheasant, Elliot's	*Syrmaticus ellioti*	China	Entire	E	15	NA	NA
Pheasant, imperial	*Lophura imperialis*	Vietnam	Entire	E	3	NA	NA
Pheasant, Mikado	*Syrmaticus mikado*	Taiwan	Entire	E	3	NA	NA
Pheasant, Palawan peacock	*Polyplectron emphanum*	Philippines	Entire	E	3	NA	NA
Pheasant, Sclater's monal	*Lophophorus sclateri*	Burma, China, India	Entire	E	3	NA	NA
Pheasant, Swinhoe's	*Lophura swinhoii*	Taiwan	Entire	E	3	NA	NA
Pheasant, western tragopan	*Tragopan melanocephalus*	India, Pakistan	Entire	E	3	NA	NA
Pheasant, white eared	*Crossoptilon crossoptilon*	China (Tibet), India	Entire	E	4	NA	NA
Pigeon, Azores wood	*Columba palumbus azorica*	East Atlantic Ocean: Azores	Entire	E	3	NA	NA
Pigeon, Chatham Island	*Hemiphaga novaeseelandiae chathamensis*	New Zealand	Entire	E	3	NA	NA
Pigeon, Mindoro zone-tailed	*Ducula mindorensis*	Philippines	Entire	E	15	NA	NA
Pigeon, Puerto Rican plain	*Columba inornata wetmorei*	U.S.A. (Puerto Rico)	Entire	E	2	NA	NA
Piping-guan, black-fronted	*Pipile jacutinga*	Argentina	Entire	E	15	NA	NA
Pitta, Koch's	*Pitta kochi*	Philippines	Entire	E	15	NA	NA
Plover, New Zealand shore	*Thinornis novaeseelandiae*	New Zealand	Entire	E	3	NA	NA
Poo-uli	*Melamprosops phaeosoma*	U.S.A. (Hawaii)	Entire	E	10	NA	NA
Prairie chicken, Attwater's greater	*Tympanuchus cupido attwateri*	U.S.A. (Texas)	Entire	E	1	NA	NA
Quail, Merriam's Montezuma	*Cyrtonyx montezumae merriami*	Mexico (Vera Cruz)	Entire	E	15	NA	NA
Quetzal, resplendent	*Pharomachrus mocinno*	Mexico to Panama	Entire	E	15	NA	NA
Rail, Aukland Island	*Rallus pectoralis muelleri*	New Zealand	Entire	E	3	NA	NA
Rail, California clapper	*Rallus longirostris obsoletus*	U.S.A. (California)	Entire	E	2	NA	NA
Rail, light-footed clapper	*Rallus longirostris levipes*	U.S.A. (California), Mexico (Baja California)	Entire	E	2	NA	NA
Rail, Lord Howe wood	*Tricholimnas sylvestris*	Australia (Lord Howe Island)	Entire	E	15	NA	NA
Rail, Yuma clapper	*Rallus longirostris yumanensis*	Mexico, U.S.A. (AZ, CA)	Entire	E	1	NA	NA
Rhea, Darwin's	*Pterocnemia pennata*	Argentina, Bolivia, Peru, Uruguay	Entire	E	3	NA	NA
Robin, Chatham Island	*Petroica traversi*	New Zealand	Entire	E	3	NA	NA
Robin, scarlet-breasted (flycatcher)	*Petroica multicolor multicolor*	Australia (Norfolk Island)	Entire	E	3	NA	NA
Rockfowl, grey-necked	*Picathartes oreas*	Cameroon	Entire	E	3	NA	NA
Rockfowl, white-necked	*Picathartes gymnocephalus*	Africa: Togo to Sierra Leone	Entire	E	3	NA	NA
Roller, long-tailed ground	*Uratelornis chimaera*	Malagasy Republic (= Madagascar)	Entire	E	3	NA	NA
Scrub-bird, noisy	*Atrichornis clamosus*	Australia	Entire	E	3	NA	NA
Shama, Cebu black (thrush)	*Copsychus niger cebuensis*	Philippines	Entire	E	3	NA	NA
Shearwater, Newell's Manx	*Puffinus puffinus newelli*	U.S.A. (Hawaii)	Entire	T	10	NA	NA
Shrike, San Clemente loggerhead	*Lanius ludovicianus mearnsi*	U.S.A. (California)	Entire	E	26	NA	NA
Siskin, red	*Carduelis (= Spinus) cucullatus*	South America	Entire	E	15	NA	NA
Sparrow, Cape Sable seaside	*Ammospiza maritima mirabilis*	U.S.A. (Florida)	Entire	E	1	17.95(b)	NA
Sparrow, dusky seaside	*Ammospiza maritima nigrescens*	U.S.A. (Florida)	Entire	E	1	17.95(b)	NA
Sparrow, San Clemente sage	*Amphispiza belli clementeae*	U.S.A. (California)	Entire	T	26	NA	NA
Sparrow, Santa Barbara song	*Melospiza melodia graminea*	U.S.A. (California)	Entire	E	6	NA	NA
Starling, Ponape mountain	*Aplonis pelzelni*	West Pacific Ocean: U.S.A. (Caroline Island)	Entire	E	3	NA	NA
Starling, Rothschild's (myna)	*Leucopsar rothschildi*	Indonesia (Bali)	Entire	E	3	NA	NA
Stilt, Hawaiian	*Himantopus himantopus knudseni*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Stork, oriental white	*Ciconia ciconia boyciana*	China, Japan, Korea, U.S.S.R.	Entire	E	3	NA	NA
Teal, Campbell Island flightless	*Anas aucklandica nesiotis*	New Zeland (Campbell Island)	Entire	E	15	NA	NA
Tern, California least	*Sterna albifrons browni*	Mexico, U.S.A. (CA)	Entire	E	2, 3	NA	NA
Thrasher, white-breasted	*Ramphocinclus brachyurus*	West Indies: St. Lucia, Martinique	Entire	E	3	NA	NA
Thrush, large Kauai	*Phaeornis obscurus myadestina*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Thrush, Molokai (= olomau)	*Phaeornis obscurus rutha*	U.S.A. (Hawaii)	Entire	E	2	NA	NA
Thrush, New Zealand (wattlebird)	*Turnagra capensis*	New Zealand	Entire	E	3	NA	NA
Thursh, small Kauai (= puaiohi)	*Phaeornis palmeri*	U.S.A. (Hawaii)	Entire	E	1	NA	NA
Tinamou, solitary	*Tinamus solitarius*	Brazil, Paraguay, Argentina	Entire	E	15	NA	NA
Trembler, Martinique brown (thrasher)	*Cinclocerthia ruficauda gutturalis*	West Indies: Martinique	Entire	E	3	NA	NA
Wanderer, plain	*Pedionomous torquatus*	Australia	Entire	E	8	NA	NA
Warbler (wood), Bachman's	*Vermivora bachmanii*	Cuba, U.S.A. (Southeastern)	Entire	E	1, 3	NA	NA
Warbler (wood), Barbados yellow	*Dendroica petechia petechia*	West Indies: Barbados	Entire	E	3	NA	NA
Warbler (wood), Kirtland's	*Dendroica kirtlandii*	U.S.A. (principally MI), Canada, West Indies: Bahama Islands	Entire	E	1, 3	NA	NA

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Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Warbler (willow), reed	*Acrocephalus luscinia*	Western Pacific Ocean: Mariana Islands.	Entire	E	3	NA	NA
Warbler (willow), Rodrigues	*Bebromis rodericanus*	Mauritius (Rodrigues Islands)	Entire	E	3	NA	NA
Warbler (wood), Semper's	*Leucopeza semperi*	West Indies: St. Lucia	Entire	E	3	NA	NA
Warbler (willow), Seychelles	*Bebromis sechellensis*	Indian Ocean: Seychelles Island	Entire	E	3	NA	NA
Whipbird, Western	*Psophodes nigrogularis*	Australia	Entire	E	3	NA	NA
Whip-poor-will, Puerto Rican	*Caprimulgus noctitherus*	U.S.A. (Puerto Rico)	Entire	E	6	NA	NA
White-eye, Norfolk Island	*Zosterops albogularis*	Indian Ocean: Norfolk Islands	Entire	E	15	NA	NA
White-eye, Ponape great	*Rukia longirostra (= sanfordi)*	West Pacific Ocean: U.S.A. (Caroline Islands).	Entire	E	3	NA	NA
White-eye, Seychelles	*Zosterops modesta*	Indian Ocean: Seychelles	Entire	E	3	NA	NA
Woodpecker, imperial	*Campephilus imperialis*	Mexico	Entire	E	3	NA	NA
Woodpecker, ivory-billed	*Campephilus principalis*	U.S.A. (southcentral and southeastern), Cuba.	Entire	E	1, 3	NA	NA
Woodpecker, red-cockaded	*Picoides (= Dendrocopos) borealis.*	U.S.A. (southcentral and southeastern).	Entire	E	2	NA	NA
Woodpecker, Tristam's	*Dryocopus javensis richardsi*	Korea	Entire	E	3	NA	NA
Wren, Guadeloupe house	*Troglodytes aedon guadeloupensis.*	West Indies: Guadeloupe	Entire	E	3	NA	NA
Wren, St. Lucia house	*Troglodytes aedon mesoleucus*	West Indies: St. Lucia	Entire	E	3	NA	NA
REPTILES							
Alligator, American	*Alligator mississippiensis*	Southeastern U.S.A	Wherever found in wild except those areas where listed as threatened as set forth below.	E	1, 11, 51, 60	NA	NA
Alligator, American	*Alligator mississippiensis*	Southeastern U.S.A	U.S.A. (FL and certain areas of GA, LA [except in those parishes listed as T(S/A)], SC, TX).	T	20, 47, 51, 60	NA	17.42(a)
Alligator, American	*Alligator mississippiensis*	Southeastern U.S.A	U.S.A. (In wild in LA [Cameron, St. Mary, Vermilion, Iberia, Terrebonne, St. Charles, LaFourche, St. Bernard, St. Tammany, Jefferson, Calcasieu, and Plaquemines Parishes]).	T(S/A)	11, 47, 51, 60	NA	17.42(a)
Alligator, American	*Alligator mississippiensis*	Southeastern U.S.A	In captivity wherever found.	T(S/A)	11, 47, 51	NA	17.42(a)
Alligator, Chinese	*Alligator sinensis*	China	Entire	E	15	NA	NA
Anole, Culebra giant	*Anolis roosevelti*	U.S.A. (Puerto Rico: Culebra Island).	Entire	E	25	17.95(c)	NA
Boa, Jamaican	*Epicrates subflavus*	Jamaica	Entire	E	3	NA	NA
Boa, Mona	*Epicrates monensis monensis*	U.S.A. (Puerto Rico)	Entire	T	30	17.95(c)	NA
Boa, Puerto Rico	*Epicrates inornatus*	U.S.A. (Puerto Rico)	Entire	E	2	NA	NA
Boa, Round Island [no common name].	*Casarea dussumieri*	Indian Ocean: Mauritius	Entire	E	88	NA	NA
Boa, Round Island [no common name].	*Bolyeria multocarinata*	Indian Ocean: Mauritius	Entire	E	89	NA	NA
Boa, Virgin Islands tree	*Epicrates monensis granti*	U.S. and British Virgin Islands	Entire	E	86	NA	NA
Caiman, Apaporis River	*Caiman crocodilus apaporiensis*	Colombia	Entire	E	15	NA	NA
Caiman, black	*Melanosuchus niger*	Amazon basin	Entire	E	15	NA	NA
Caiman, broad-snouted	*Caiman latirostris*	Brazil, Argentina, Paraguay, Uruguay.	Entire	E	15	NA	NA
Caiman, Yacare	*Caiman crocodilus yacare*	Bolivia, Argentina, Peru, Brazil	Entire	E	3	NA	NA
Chuckwalla, San Esteban Island	*Sauromalus varius*	Mexico	Entire	E	88	NA	NA
Crocodile, African dwarf	*Osteolaemus tetraspis tetraspis*	West Africa	Entire	E	15	NA	NA
Crocodile, African slender-snouted	*Crocodylus cataphractus*	Western and central Africa	Entire	E	5	NA	NA
Crocodile, American	*Crocodylus acutus*	U.S.A. (FL), Mexico, South America, Central America, Caribbean.	Entire	E	10, 87	17.95(c)	NA
Crocodile, Ceylon mugger	*Crocodylus palustris kimbula*	Sri Lanka	Entire	E	15	NA	NA
Crocodile, Congo dwarf	*Osteolaemus tetraspis osborni*	Congo River drainage	Entire	E	15	NA	NA
Crocodile, Cuban	*Crocodylus rhombifer*	Cuba	Entire	E	3	NA	NA
Crocodile, Morelet's	*Crocodylus moreletii*	Mexico, Belize, Guatemala	Entire	E	3	NA	NA
Crocodile, mugger	*Crocodylus palustris palustris*	India, Pakistan, Iran, Bangladesh	Entire	E	15	NA	NA
Crocodile, Nile	*Crocodylus niloticus*	Africa	Entire	E	3	NA	NA
Crocodile, Orinoco	*Crocodylus intermedius*	South America: Orinoco River Basin.	Entire	E	3	NA	NA
Crocodile, Philippine	*Crocodylus novaeguineae mindorensis.*	Philippine Islands	Entire	E	15	NA	NA
Crocodile, saltwater (= estuarine)	*Crocodylus porosus*	Southeast Asia, Australia, Papua-New Guinea, Pacific Islands.	Entire, except Papua-New Guinea.	E	87	NA	NA
Crocodile, Siamese	*Crocodylus siamensis*	Southeast Asia, Malay Peninsula	Entire	E	15	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Gavial (=gharial)	*Gavialus gangeticus*	Pakistan, Burma, Bangladesh, India.	Entire	E	3, 15	NA	NA
Gecko, day	*Phelsuma newtoni*	Indian Ocean: Mauritius	Entire	E	3	NA	NA
Gecko, Round Island day	*Phelsuma guentheri*	Indian Ocean: Mauritius	Entire	E	3	NA	NA
Iguana, Anegada ground	*Cyclura pinguis*	West Indies: British Virgin Islands (Anegada Island).	Entire	E	3	NA	NA
Iguana, Barrington land	*Conolophus pallidus*	Ecuador (Galapagos Island)	Entire	E	3	NA	NA
Iguana, Fiji banded	*Brachylophus fasciatus*	Fiji, Tonga	Entire	E	86	NA	NA
Iguana, Fiji crested	*Brachylophus sp*	Fiji	Entire	E	86	NA	NA
Iguana, Mona ground	*Cyclura stejnegeri*	U.S.A. (Puerto Rico: Mona Island)	Entire	T	30	17.95(c)	NA
Lizard, blunt-nosed leopard	*Crotaphytus silus*	U.S.A. (California)	Entire	E	1	NA	NA
Lizard, island night	*Klauberina riversiana*	U.S.A. (California)	Entire	T	26	NA	NA
Lizard, St. Croix ground	*Ameiva polops*	U.S.A. (Virgin Islands: Green Cay, Protestant Cay).	Entire	E	24	17.95(c)	NA
Monitor, Bengal	*Varanus bengalensis*	Iran, Iraq, India, Sri Lanka, Malaysia, Afghanistan, Burma, Vietnam, Thailand.	Entire	E	15	NA	NA
Monitor, desert	*Varanus griseus*	North Africa to Near East, Caspian Sea through U.S.S.R. to Pakistan, Northwest India.	Entire	E	15	NA	NA
Monitor, Komodo Island	*Varanus komodensis*	Indonesia (Komodo, Rintja, Padar, and western Flores Island.	Entire	E	15	NA	NA
Monitor, yellow	*Varanus flavescens*	West Pakistan through India to Bangladesh.	Entire	E	15	NA	NA
Python, Indian	*Python molurus molurus*	Sri Lanka and India	Entire	E	15	NA	NA
Rattlesnake, New Mexican ridge-nosed.	*Crotalus willardi obscurus*	U.S.A. (NM), Mexico	Entire	T	43	17.95(c)	NA
Snake, Atlantic salt marsh	*Nerodia fasciata taeniata*	U.S.A. (Florida)	Entire	T	30	NA	NA
Snake, eastern indigo	*Drymarchon corais couperi*	U.S.A. (AL, FL, GA, MS, SC)	Entire	T	32	NA	NA
Snake, San Francisco garter	*Thamnophis sirtalis tetrataenia*	U.S.A. (California)	Entire	E	1	NA	NA
Terrapin, river (=Tuntong)	*Batagur baska*	Malaysia, Bangladesh, Burma, India, Indonesia.	Entire	E	3	NA	NA
Tomistoma	*Tomistoma schlegelii*	Malaysia, Indonesia	Entire	E	15	NA	NA
Tortoise, angulated	*Geochelone yniphora*	Malagasy Republic (=Madagascar).	Entire	E	15	NA	NA
Tortoise, Bolson	*Gopherus flavomarginatus*	Mexico	Entire	E	46	NA	NA
Tortoise, Galapagos	*Geochelone elephantopus*	Ecuador (Galapagos Islands)	Entire	E	3	NA	NA
Tortoise, Indian flap-shell	*Lissemys punctata punctata*	India, Pakistan, Bangladesh	Entire	E	15	NA	NA
Tortoise, radiated	*Geochelone (=Testudo) radiata*	Malagasy Republic (=Madagascar).	Entire	E	3	NA	NA
Tuatara	*Sphenodon punctatus*	New Zealand	Entire	E	3	NA	NA
Turtle, aquatic box	*Terrapene coahuila*	Mexico	Entire	E	6	NA	NA
Turtle, black softshell	*Trionyx nigricans*	Bangladesh	Entire	E	15	NA	NA
Turtle, Burmese peacock	*Morenia ocellata*	Burma	Entire	E	15	NA	NA
Turtle, Cuatro Cienegas softshell	*Trionyx ater*	Mexico	Entire	E	15	NA	NA
Turtle, geometric	*Geochelone geometrica*	Union of South Africa	Entire	E	15	NA	NA
Turtle, green sea	*Chelonia mydas*	Circumglobal in tropical and temperate seas and oceans.	Wherever found except where listed as endangered below.	T	42	NA	17.42(b) and Parts 220 and 227.
Turtle, green sea	*Chelonia mydas*	Circumglobal in tropical and temperate seas and oceans.	Breeding colony populations in FL and on Pacific coast of Mexico.	E	42	NA	NA
Turtle, hawksbill sea (=carey)	*Eretmochelys imbricata*	Tropical seas	Entire	E	3	NA	NA
Turtle, Indian sawback	*Kachuga tecta tecta*	India	Entire	E	15	NA	NA
Turtle, Indian softshell	*Trionyx gangeticus*	Pakistan, India	Entire	E	15	NA	NA
Turtle, Kemp's (Atlantic) Ridley sea	*Lepidochelys kempi*	Tropical and temperate seas	Entire	E	4	NA	NA
Turtle, leatherback sea	*Dermochelys coriacea*	Tropical, temperate, and subpolar seas.	Entire	E	3	17.95(c)	NA
Turtle, loggerhead sea	*Caretta caretta*	Circumglobal in tropical and temperate seas and oceans.	Entire	T	42	NA	17.42(b) and Parts 220 and 227.
Turtle, Olive (Pacific) Ridley sea	*Lepidochelys olivacea*	Circumglobal in tropical and temperate seas and oceans.	Wherever found except where listed as endangered below.	T	42	NA	17.42(b) and Parts 220 and 227.
Turtle, Olive (Pacific) Ridley sea	*Lepidochelys olivacea*	Circumglobal in tropical and temperate seas and oceans.	Breeding colony populations on Pacific coast of Mexico.	E	42	NA	NA
Turtle, peacock softshell	*Trionyx hurum*	India, Bangladesh	Entire	E	15	NA	NA
Turtle, Plymouth red-bellied	*Chrysemys (=Pseudemys) rubriventris bangsi*	U.S.A. (Massachusetts)	Entire	E	90	17.95(c)	NA
Turtle, short-necked or western swamp	*Pseudemydura umbrina*	Australia	Entire	E	3	NA	NA
Turtle, South American river [no common name]	*Podocnemis expansa*	South America: Orinoco and Amazon River basins.	Entire	E	3	NA	NA
Turtle, South American river [no common name]	*Podocnemis unifilis*	South America: Orinoco and Amazon River basins.	Entire	E	3	NA	NA
Turtle, spotted pond	*Geoclemmys (=Damonia) hamiltonii*	North India, Pakistan	Entire	E	15	NA	NA
Turtle, three-keeled Asian	*Geoemyda (=Nicoria) tricarinata*	Central India to Bangladesh and Burma	Entire	E	15	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
AMPHIBIANS							
Coqui, golden	*Eleutherodactylus jasperi*	U.S.A. (Puerto Rico)	Entire	T	29	17.95(d)	NA
Frog, Israel painted	*Discoglossus nigriventer*	Israel	Entire	E	3	NA	NA
Frog, Panamanian golden	*Atelopus varius zeteki*	Panama	Entire	E	15	NA	NA
Frog, Stephen Island	*Leiopelma hamiltoni*	New Zealand	Entire	E	3	NA	NA
Salamander, Chinese giant	*Andrias davidianus davidianus*	Western China	Entire	E	15	NA	NA
Salamander, desert slender	*Batrachoseps aridus*	U.S.A. (California)	Entire	E	6	NA	NA
Salamander, Japanese giant	*Andrias davidianus japonicus*	Japan	Entire	E	15	NA	NA
Salamander, Red Hills	*Phaeognathus hubrichti*	U.S.A. (Alabama)	Entire	T	19	NA	NA
Salamander, Santa Cruz long-toed	*Ambystoma macrodactylum croceum.*	U.S.A. (California)	Entire	E	1	NA	NA
Salamander, Texas blind	*Typhlomolge rathbuni*	U.S.A. (Texas)	Entire	E	1	NA	NA
Toad, African viviparous	*Nectophrynoides spp*	Tanzania, Guinea	Entire	E	15	NA	NA
Toad, Cameroon	*Bufo superciliaris*	Equatorial Africa	Entire	E	15	NA	NA
Toad, Houston	*Bufo houstonensis*	U.S.A. (Texas)	Entire	E	2	17.95(d)	NA
Toad, Monte Verde	*Bufo periglenes*	Costa Rica	Entire	E	15	NA	NA
Treefrog, pine barrens	*Hyla andersonii*	U.S.A. (FL, AL, NC, SC, NJ)	Florida	E	29	17.95(d)	NA
FISHES							
Ala Balik (trout)	*Salmo platycephalus*	Turkey	Entire	E	3	NA	NA
Ayumodoki (loach)	*Hymenophysa (=Botia) curta*	Japan	Entire	E	3	NA	NA
Blindcat, Mexican	*Prietella phreatophila*	Mexico	Entire	E	3	NA	NA
Bonytail, Pahranagat	*Gila robusta jordani*	U.S.A. (Nevada)	Entire	E	2	NA	NA
Bonytongue, Asian	*Scleropages formosus*	Thailand, Indonesia, Malaysia	Entire	E	15	NA	NA
Catfish (no common name)	*Pangasius sanitwongsei*	Thailand	Entire	E	3	NA	NA
Catfish, giant	*Pangasianodon gigas*	Thailand	Entire	E	3	NA	NA
Cavefish, Alabama	*Speoplatyrhinus poulsoni*	U.S.A. (Alabama)	Entire	T	25	17.95(e)	NA
Chub, bonytail	*Gila elegans*	U.S.A. (AZ, CA, CO, NV, UT, WY)	Entire	E	92	NA	NA
Chub, humpback	*Gila cypha*	U.S.A. (AZ, CO, UT, WY)	Entire	E	1	NA	NA
Chub, Mohave	*Gila mohavensis*	U.S.A. (California)	Entire	E	2	NA	NA
Chub, slender	*Hybopsis cahni*	U.S.A. (TN, VA)	Entire	T	28	17.95(e)	17.44(c)
Chub, spotfin	*Hybopsis monacha*	U.S.A. (AL, GA, NC, TN, VA)	Entire	T	28	17.95(e)	17.44(c)
Cicek (minnow)	*Acanthorutilus handlirschi*	Turkey	Entire	E	3	NA	NA
Cisco, longjaw	*Coregonus alpenae*	U.S.A. and Canada (Lakes Michigan, Huron, Erie).	Entire	E	1, 4	NA	NA
Cui-ui	*Chasmistes cujus*	U.S.A. (Nevada)	Entire	E	1	NA	NA
Dace, Kendall Warm Springs	*Rhinichthys osculus thermalis*	U.S.A. (Wyoming)	Entire	E	2	NA	NA
Dace, Moapa	*Moapa coriacea*	U.S.A. (Nevada)	Entire	E	1	NA	NA
Darter, bayou	*Etheostoma rubrum*	U.S.A. (Mississippi)	Entire	T	10	NA	17.44(b)
Darter, fountain	*Etheostoma fonticola*	U.S.A. (Texas)	Entire	E	2	NA	NA
Darter, leopard	*Percina pantherina*	U.S.A. (AR, OK)	Entire	T	31	17.95(e)	17.44(d)
Darter, Maryland	*Etheostoma sellare*	U.S.A. (Maryland)	Entire	E	1	NA	NA
Darter, Okaloosa	*Etheostoma okaloosae*	U.S.A. (Florida)	Entire	E	6	NA	NA
Darter, slackwater	*Etheostoma boschungi*	U.S.A. (AL, TN)	Entire	T	29	NA	17.44(c)
Darter, snail	*Percina tanasi*	U.S.A. (Tennessee)	Entire	E	12	NA	NA
Darter, watercress	*Etheostoma nuchale*	U.S.A. (Alabama)	Entire	E	2	NA	NA
Gambusia, Big Bend	*Gambusia gaigei*	U.S.A. (Texas)	Entire	E	1	NA	NA
Gambusia, Clear Creek	*Gambusia heterochir*	U.S.A. (Texas)	Entire	E	1	NA	NA
Gambusia, Goodenough	*Gambusia amistadensis*	U.S.A. (Texas)	Entire	E	93	NA	NA
Gambusia, Pecos	*Gambusia nobilis*	U.S.A. (NM, TX)	Entire	E	2	NA	NA
Killifish, Pahrump	*Empetrichythys latos*	U.S.A. (Nevada)	Entire	E	1	NA	NA
Madtom, Scioto	*Noturus trautmani*	U.S.A. (Ohio)	Entire	E	10	NA	NA
Madtom, yellowfin	*Noturus flavipinnis*	U.S.A. (GA, TN, VA)	Entire	T	28	NA	17.44(c)
Nekogigi	*Coreobagrus ichikawai*	Japan	Entire	E	3	NA	NA
Pike, blue	*Stizostedion vitreum glaucum*	U.S.A. and Canada (Lakes Erie, Ontario).	Entire	E	1	NA	NA
Pupfish, Comanche Springs	*Cyprinodon elegans*	U.S.A. (Texas)	Entire	E	1	NA	NA
Pupfish, Devil's Hole	*Cyprinodon diabolis*	U.S.A. (Nevada)	Entire	E	1	NA	NA
Pupfish, Owens River	*Cyprinodon radiosus*	U.S.A. (California)	Entire	E	1	NA	NA
Pupfish, Tecopa	*Cyprinodon nevadensis calidae*	U.S.A. (California)	Entire	E	2	NA	NA
Pupfish, Warm Springs	*Cyprinodon nevadensis pectoralis*	U.S.A. (Nevada)	Entire	E	2	NA	NA
Squawfish, Colorado River	*Ptychocheilus lucius*	U.S.A. (AZ, CA, CO, NM, NV, UT, WY).	Entire	E	1	NA	NA
Stickleback, unarmored threespine	*Gasterosteus aculeatus williamsoni.*	U.S.A. (California)	Entire	E	2	NA	NA
Sturgeon, shortnose	*Acipenser brevirostrum*	U.S.A. and Canada (Atlantic Coast).	Entire	E	1	NA	NA
Tango, Miyako (Tokyo bitterling)	*Tanakia tanago*	Japan	Entire	E	3	NA	NA
Temoleh, Ikan (minnow)	*Probarbus jullieni*	Thailand, Cambodia, Vietnam, Malaysia, Laos.	Entire	E	15	NA	NA
Topminnow, Gila	*Poeciliopsis occidentalis*	U.S.A. (AZ, NM), Mexico	Entire	E	1	NA	NA
Totoaba (seatrout or weakfish)	*Cynoscion macdonaldi*	Mexico (Gulf of California)	Entire	E	45	NA	NA
Trout, Arizona	*Salmo apache*	U.S.A. (Arizona)	Entire	T	1, 6	NA	17.44(a)
Trout, Gila	*Salmo gilae*	U.S.A. (New Mexico)	Entire	E	1	NA	NA
Trout, greenback cutthroat	*Salmo clarki stomias*	U.S.A. (Colorado)	Entire	T	1, 30	NA	17.44(f)
Trout, Lahontan cutthroat	*Salmo clarki henshawi*	U.S.A. (CA, NV)	Entire	T	2, 8	NA	17.44(a)
Trout, Little Kern golden	*Salmo aguabonita whitei*	U.S.A. (California)	Entire	T	37	17.95(e)	17.44(e)
Trout, Paiute cutthroat	*Salmo clarki seleniris*	U.S.A. (California)	Entire	T	1, 8	NA	17.44(a)
Woundfin	*Plagopterus argentissimus*	U.S.A. (AZ, NV, UT)	Entire	E	2	NA	NA
SNAILS							
Snail, Chittenango ovate amber	*Succinea chittenangoensis*	U.S.A. (New York)	NA	T	41	NA	NA
Snail, flat-spired three-toothed	*Triodopsis platysayoides*	U.S.A. (West Virginia)	NA	T	41	NA	NA
Snail, Iowa Pleistocene	*Discus macclintocki*	U.S.A. (Iowa)	NA	E	41	NA	NA
Snail, Manus Island tree	*Papustyla pulcherrima*	Admiralty Islands (Manus Islands)	NA	E	3	NA	NA
Snail, noonday	*Mesodon clarki nantahala*	U.S.A. (North Carolina)	NA	T	41	NA	NA
Snail, painted snake coiled forest	*Anguispira picta*	U.S.A. (Tennessee)	NA	T	41	NA	NA
Snail, Stock Island	*Orthalicus reses*	U.S.A. (Florida)	NA	T	41	NA	NA
Snail, Virginia fringed mountain	*Polygyriscus virginianus*	U.S.A. (Virginia)	NA	E	41	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
CLAMS							
Pearly mussel, Alabama lamp	*Lampsilis virescens*	U.S.A. (AL, TN)	NA	E	15	NA	NA
Pearly mussel, Appalachian monkeyface.	*Quadrula sparsa*	U.S.A. (TN, VA)	NA	E	15	NA	NA
Pearly mussel, birdwing	*Conradilla caelata*	U.S.A. (TN, VA)	NA	E	15	NA	NA
Pearly mussel, Cumberland bean	*Villosa (=Micromya) trabalis*	U.S.A. (Kentucky)	NA	E	15	NA	NA
Pearly mussel, Cumberland monkeyface.	*Quadrula intermedia*	U.S.A. (AL, TN, VA)	NA	E	15	NA	NA
Pearly mussel, Curtis'	*Epioblasma (=Dysnomia) florentina curtisi*	U.S.A. (Missouri)	NA	E	15	NA	NA
Pearly mussel, dromedary	*Dromus dromas*	U.S.A. (TN, VA)	NA	E	15	NA	NA
Pearly mussel, green-blossom	*Epioblasma (=Dysnomia) torulosa gubernaculum.*	U.S.A. (TN, VA)	NA	E	15	NA	NA
Pearly mussel, Higgin's eye	*Lampsilis higginsi*	U.S.A. (IL, IA, MN, MO, NE, WI)	NA	E	15	NA	NA
Pearly mussel, Nicklin's	*Megalonaias nicklineana*	Mexico	NA	E	15	NA	NA
Pearly mussel, orange-footed	*Plethobasis cooperianus*	U.S.A. (AL, IN, IA, KY, OH, PA, TN).	NA	E	15	NA	NA
Pearly mussel, pale lilliput	*Toxolasma (=Carunculina) cylindrella.*	U.S.A. (AL, MO, TN, WV)	NA	E	15	NA	NA
Pearly mussel, pink mucket	*Lampsilis orbiculata*	U.S.A. (AL, IL, IN, KY, MO, OH, PA, TN, WV).	NA	E	15	NA	NA
Pearly mussel, Sampson's	*Epioblasma (=Dysnomia) sampsoni.*	U.S.A. (IL, IN)	NA	E	15	NA	NA
Pearly mussel, Tampico	*Cyrtonaias tampicoensis tecomatensis.*	Mexico	NA	E	15	NA	NA
Pearly mussel, tuberculed-blossom	*Epioblasma (=Dysnomia) torulosa torulosa.*	U.S.A. (IL, KY, TN, WV)	NA	E	15	NA	NA
Pearly mussel, turgid-blossom	*Epioblasma (=Dysnomia) turgidula.*	U.S.A. (AL, AR, MO, TN)	NA	E	15	NA	NA
Pearly mussel, white cat's eye	*Epioblasma (=Dysnomia) sulcata delicata.*	U.S.A. (IN, MI, OH)	NA	E	15	NA	NA
Pearly mussel, white wartyback	*Plethobasis cicatricosus*	U.S.A. (AL, TN)	NA	E	15	NA	NA
Pearly mussel, yellow-blossom	*Epioblasma (=Dysnomia—florentina florentina.*	U.S.A. (AL, TN)	NA	E	15	NA	NA
Pigtoe, fine-rayed	*Fusconaia cuneolus*	U.S.A. (AL, TN, VA)	NA	E	15	NA	NA
Pigtoe, rough	*Pleurobema plenum*	U.S.A. (KY, TN, VA)	NA	E	15	NA	NA
Pigtoe, shiny	*Fusconaia edgariana*	U.S.A. (AL, TN, VA)	NA	E	15	NA	NA
Pocketbook, fat	*Potamilus (=Proptera) capax*	U.S.A. (AR, IN, MO, OH)	NA	E	15	NA	NA
Riffle shell clam, tan	*Epioblasma walkeri*	U.S.A. (KY, TN, VA)	NA	E	27	NA	NA
CRUSTACEANS							
Isopod, Socorro	*Exosphaeroma thermophilus*	U.S.A. (New Mexico)	NA	E	35	NA	NA
INSECTS							
Butterfly, Bahama swallowtail	*Papilio andraemon bonhotei*	U.S.A. (FL), Bahamas	NA	T	13	NA	17.47(a)
Butterfly, El Segundo blue	*Euphilotes (=Shijimiaeoides) battoides allyni.*	U.S.A. (California)	NA	E	14	NA	NA
Butterfly, Lange's metalmark	*Apodemia mormo langei*	U.S.A. (California)	NA	E	14	NA	NA
Butterfly, Lotis blue	*Lycaeides argyrognomon lotis*	U.S.A. (California)	NA	E	14	NA	NA
Butterfly, mission blue	*Icaricia icarioides missionensis*	U.S.A. (California)	NA	E	14	NA	NA
Butterfly, San Bruno elfin	*Callophrys mossii bayensis*	U.S.A. (California)	NA	E	14	NA	NA
Butterfly, Schaus swallowtail	*Papilio aristodemus ponceanus*	U.S.A. (Florida)	NA	T	13	NA	17.47(a)
Butterfly, Smith's blue	*Euphilotes (=Shijimiaeoides) enoptes smithi*	U.S.A. (California)	NA	E	14	NA	NA
Moth, Kern primrose sphinx	*Euproserpinus euterpe*	U.S.A. (California)	NA	T	91	NA	NA

1—32 FR 4001; March 11, 1967.
2—35 FR 16047; October 13, 1970.
3—35 FR 8495; June 2, 1970.
4—35 FR 18320; December 2, 1970.
5—37 FR 6476; March 30, 1972.
6—38 FR 14678; June 4, 1973.
7—39 FR 44991; December 30, 1974.
8—40 FR 29864; July 16, 1975.
9—40 FR 31736; July 28, 1975.
10—40 FR 44151; September 25, 1975.
11—40 FR 44418; September 26, 1975.
12—40 FR 47506; October 9, 1975.
13—41 FR 17740; April 28, 1976.
14—41 FR 22044; June 1, 1976.
15—41 FR 24064; June 14, 1976.
16—41 FR 45993; October 19, 1976.
17—41 FR 51021; November 19, 1976.
18—41 FR 51612; November 23, 1976.
19—41 FR 53034; December 3, 1976.
20—42 FR 2076; January 10, 1977.
21—42 FR 2968; January 14, 1977.
22—42 FR 28056; June 1, 1977.
23—42 FR 28137; June 2, 1977.
24—42 FR 28545; June 3, 1977.
25—42 FR 37373; July 21, 1977.
26—42 FR 40685; August 11, 1977.
27—42 FR 42353; August 23, 1977
28—42 FR 45528; September 9, 1977
29—42 FR 58755; November 11, 1977
30—42 FR 60745; November 29, 1977.
31—43 FR 3715; January 27, 1978.
32—43 FR 4028; January 31, 1978.
33—43 FR 4621; February 3, 1978.
34—43 FR 6233; February 14, 1978.
35—43 FR 9612; March 9, 1978.
36—43 FR 12691; March 27, 1978.
37—43 FR 15429; April 13, 1978.
38—43 FR 16345; April 18, 1978.
40—43 FR 20504; May 12, 1978.
41—43 FR 28932; July 3, 1978.
42—43 FR 32808; July 28, 1978.
43—43 FR 34479; August 4, 1978.
44—43 FR 44812; September 29, 1978.
45—44 FR 21289; April 10, 1979.
46—44 FR 23064; April 17, 1979.
48—44 FR 29480; May 21, 1979.
50—44 FR 37126; June 25, 1979.
51—44 FR 37132; June 25, 1979.
52—44 FR 42911; July 20, 1979.
54—44 FR 49220; August 21, 1979.
55—44 FR 54007; September 17, 1979.
60—44 FR 59084; October 12, 1979.
65—44 FR 69206; November 30, 1979.
66—44 FR 70677; December 7, 1979.
67—44 FR 75076; December 18, 1979.
89—45 FR 18010; March 20, 1980.
90—45 FR 21833; April 2, 1980.
91—45 FR 24090; April 8, 1980.
92—45 FR 27713; April 23, 1980
93—45 FR 28722; April 30, 1980.

#—indicates FR where species was deleted; relisting of the species is indicated by subsequent number(s).
E—indicates Emergency rule publication (see FR document for effective dates); subsequent number(s) indicate FR final rule, if applicable.

10-13

§ 17.12 Endangered and threatened plants.

(a) The list in this section contains all species of plants which are determined by the Director to be Endangered or Threatened. It also contains species of plants treated as Endangered or Threatened because they are similar in appearance to an Endangered or Threatened species (see § 17.50 *et seq.*)

(b) The columns entitled "Scientific Name" and "Common Name" define a species of plant within the meaning of the Act. Although common names are usually included, they cannot be relied upon for identification of any specimen, since they may vary greatly with local usage. The Director will use the most recently accepted scientific name. In cases in which confusion might arise, a synonym will be provided in parentheses. The Services shall rely to the extent practical on the *International Code of Botanical Nomenclature.*

(c) In the "Status" column the following symbols are used: "E" for Endangered, "T" for Threatened, and "E (or T) (S/A)" for similarity of appearance species.

(d) For information purposes only, the "Historic Range" indicates the general known distribution of the species or subspecies as reported in the scientific literature. The present distribution may be greatly reduced from this historic range. This column does not imply any limitation on the application of the prohibitions in the Act or implementing rules. Such prohibitions apply to all individuals of the species, wherever found. When the list is updated annually any change in the range will be added.

(e) For informational purposes only, a footnote to the **Federal Register** publication which originally listed the species is provided under the column "When Listed." Footnote numbers to § 17.12 and § 17.11 are in same numerical sequence since plants and animals may be listed in the **Federal Register** document. That document includes a statement indicating the basis for listing.

(f) The "Special Rules" and "Critical Habitat" columns provide a cross reference to other sections in this Part 17 or Parts 222 or 227. The term "N/A" (not applicable) appearing in either of these two columns indicates that there are no special rules and/or Critical Habitat for that particular species. However, all other appropriate rules in this Part 17 still apply to that species. In addition, there may be other rules in this Title that relate to such plants, e.g., port-of-entry requirements. It is not intended that the references in the "Special Rules" column list all the regulations of the two Services which might apply to the plants in question or to the regulations of other Federal agencies or State or local governments.

(g) The listing of a particular taxonomic group includes all its lower taxonomic units [see § 17.11(g) for examples]

(h) The "List of Endangered and Threatened Plants" is provided below:

Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
Plants:						
Alismataceae—Water-plantain family:						
Sagittaria fasciculata	Bunched arrowhead	U.S.A. (NC, SC)	E	51	NA	NA
Asteraceae—Aster family:						
Echinacea tennesseensis	Tennessee purple coneflower	U.S.A. (TN)	E	49	NA	NA
Lipochaeta venosa	None	U.S.A. (HI)	E	73	NA	NA
Berberidaceae—Barberry family:						
Berberis sonnei	Truckee barberry	U.S.A. (CA)	E	75	NA	NA
Betulaceae—Birch family:						
Betula uber	Virginia round-leaf birch	U.S.A. (VA)	E	39	NA	NA
Brassicaceae—Mustard family:						
Arabis mcdonaldiana	McDonald's rock-cress	U.S.A. (CA)	E	44	NA	NA
Erysimum capitatum var. angustatum	Contra Costa wallflower	U.S.A. (CA)	E	39	17.96(a)	NA
Cactaceae—Cactus family:						
Ancistrocactus tobuschii (= *Echinocactus t., Mammillaria t.*)	Tobusch fishhook cactus	U.S.A. (TX)	E	80	NA	NA
Coryphantha minima (= *C. nellieae, Escobaria n., Mammillaria n.*)	Nellie cory cactus	U.S.A. (TX)	E	81	NA	NA
Coryphantha ramillosa	Bunched cory cactus	U.S.A. (TX), Mexico (Coahuila).	T	77	NA	NA
Coryphantha sneedii var. leei (= *Escobaria l., Mammillaria l.*)	Lee pincushion cactus	U.S.A. (NM)	T	61	NA	NA
Coryphantha sneedii var. sneedii (= Escobaria s., Mammillaria s.)	Sneed pincushion cactus	U.S.A. (TX, NM)	E	62	NA	NA
Echinocactus horizonthalonius var. nicholii	Nichol's Turk's head cactus	U.S.A. (AZ)	E	71	NA	NA
Echinocereus engelmannii var. purpureus	Purple-spined hedgehog cactus	U.S.A. (UT)	E	58	NA	NA
Echinocereus kuenzleri (= *E. hempelii of authors, not Fobe*)	Kuenzler hedgehog cactus	U.S.A. (NM)	E	70	NA	NA
Echinocereus lloydii (= *E. roetteri var. l.*)	Lloyd's hedgehog cactus	U.S.A. (TX)	E	67	NA	NA
Echinocereus reichenbachii var. albertii (= *E. melanocentrus*)	Black lace cactus	U.S.A. (TX)	E	68	NA	NA
Echinocereus triglochidiatus var. arizonicus (= *E. arizonicus*	Arizona hedgehog cactus	U.S.A. (AZ)		62	NA	NA
Echinocereus triglochidiatus var. inermis (= *E. coccineus, var. i., E. phoeniceus var. i.*).	Spineless hedgehog cactus	U.S.A. (CO, UT).	E	83	NA	NA
Echinocereus viridiflorus var. davisii (= *E. davisii*)	Davis' green pitaya	U.S.A. (TX)	E	81	NA	NA
Neolloydia mariposensis (= *Echinocactus m., Echinomastus m.*)	Lloyd's Mariposa cactus	U.S.A. (TX)	T	77	NA	NA
Pediocactus bradyi (= *Toumeya b.*)	Brady pincushion cactus	U.S.A. (AZ)	E	60	NA	NA
Pediocactus knowltonii	Knowlton cactus	U.S.A. (NM)	E	72	NA	NA
Pediocactus peeblesianus var. peeblesianus (= *Echinocactus p., Navajoa p., Toumeya p., Utahia p.*).	Peebles Navajo cactus	U.S.A. (AZ)	E	69	NA	NA
Pediocactus sileri (= *Echinocactus s., Utahia s.*)	Siler pincushion cactus	U.S.A. (AZ, UT)	E	64	NA	NA
Sclerocactus glaucus (= *Echinocactus g., E. subglaucus, E. whipplei var. g., Pediocactus g., S. franklinii*).	Uinta Basin hookless cactus	U.S.A. (CO, UT)	T	59	NA	NA
Sclerocactus mesae-verdae (= *Coloradoa m., Echinocactus m., Pediocactus m.*)	Mesa Verde cactus	U.S.A. (CO, NM).	T	75	NA	NA
Sclerocactus wrightiae (= *Pediocactus w.*)	Wright fishhook cactus	U.S.A. (UT)	E	58	NA	NA
Crassulaceae—Stonecrop family:						
Dudleya traskiae	Santa Barbara Island liveforever	U.S.A. (CA)	E	39	NA	NA
Cupressaceae—Cypress family:						
Fitzroya cupressoides	Chilean false larch (= alerce)	Chile, Argentina	T	79	NA	NA
Ericaceae—Heath family:						
Arctostaphylos hookeri ssp. ravenii	Raven's manzanita	U.S.A. (CA)	E	65	NA	NA
Rhododendron chapmanii	Chapman rhododendron	U.S.A. (FL)	E	47	NA	NA

Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
Fabaceae—Pea family:						
Astragalus perianus	Rydberg milk-vetch	U.S.A. (UT)	T	39	NA	NA
Baptisia arachnifera	Hairy rattleweed	U.S.A. (GA)	E	39	NA	NA
Lotus scoparius ssp. traskiae	San Clemente broom	U.S.A. (CA)	E	26	NA	NA
Vicia menziesii	Hawaiian wild broad-bean	U.S.A. (HI)	E	39	NA	NA
Hydrophyllaceae—Waterleaf family:						
Phacelia argillacea	None	U.S.A. (UT)	E	44	NA	NA
Lamiaceae—Mint family:						
Haplostachys haplostachya var. angustifolia	None	U.S.A. (HI)	E	73	NA	NA
Pogogyne abramsii	San Diego mesa mint	U.S.A. (CA)	E	44	NA	NA
Stenogyne angustifolia var. angustifolia	None	U.S.A. (HI)	E	73	NA	NA
Liliaceae—Lily family:						
Harperocallis flava	Harper's beauty	U.S.A. (FL)	E	57	NA	NA
Trillium persistens	Persistent trillium	U.S.A. (GA, SC)	E	39	NA	NA
Malvaceae—Mallow family:						
Kokia cookei	Cooke's kokio	U.S.A. (HI)	E	74	NA	NA
Malacothamnus clementinus	San Clemente Island bush-mallow	U.S.A. (CA)	E	24	NA	NA
Nyctaginaceae—Four o'clock family:						
Mirabilis macfarlanei	MacFarlane's four-o'clock	U.S.A. (ID, OR)	E	66	NA	NA
Onagraceae—Evening primrose family:						
Oenothera avita ssp. eurekensis	Eureka evening-primrose	U.S.A. (CA)	E	39	NA	NA
Oenothera deltoides ssp. howellii	Antioch Dunes evening-primrose	U.S.A. (CA)	E	39	17.96(a)	NA
Papaveraceae—Poppy family:						
Arctomecon humilis	Dwarf bear-poppy	U.S.A. (UT)	E	78	NA	NA
Pinaceae—Pine family:						
Abies guatemalensis	Guatemalan fir (=pinabete)	Mexico, Guatemala, Honduras, El Salvador.	T	84	NA	NA
Poaceae—Grass family:						
Orcuttia mucronata	Solano (=Crampton's Orcutt) grass.	U.S.A. (CA)	E	44	NA	NA
Swallenia alexandrae	Eureka Dune grass	U.S.A. (CA)	E	39	NA	NA
Zizania texana	Texas wild-rice	U.S.A. (TX)	E	39	NA	NA
Ranunculaceae—Buttercup family:						
Aconitum noveboracense	Northern wild monkshood	U.S.A. (IA, NY, OH, WI).	T	39	NA	NA
Delphinium kinkiense	San Clemente Island larkspur	U.S.A. (CA)	E	26	NA	NA
Sarraceniaceae—Pitcherplant family:						
Sarracenia oreophila	Green pitcher plant	U.S.A. (AL, GA).	E	56, 89	NA	NA
Scrophulariaceae—Snapdragon family:						
Castilleja grisea	San Clemente Island Indian paintbrush.	U.S.A. (CA)	E	26	NA	NA
Cordylanthus maritimus ssp. maritimus	Salt marsh bird's beak	U.S.A. (CA), Mexico (Baja California).	E	44	NA	NA
Pedicularis furbishiae	Furbish lousewort	U.S.A. (ME), Canada (New Brunswick).	E	39	NA	NA

26—42 FR 40685; August 11, 1977.
39—43 FR 17916; April 26, 1978.
44—43 FR 44812; September 28, 1976.
47—44 FR 24250; April 24, 1979.
49—44 FR 32605; June 6, 1979.
53—44 FR 43701; July 25, 1979.
56—44 FR 54923; September 21, 1979.
57—44 FR 56863; October 2, 1979.
58—44 FR 58868; October 11, 1979.
59—44 FR 58870; October 11, 1979.
61—44 FR 61556; October 25, 1979.
62—44 FR 61558; October 26, 1979.
63—44 FR 61786; October 26, 1979.
64—44 FR 61788; October 26, 1979.
65—44 FR 61911; October 26, 1979.
66—44 FR 61913; October 26, 1979.
67—44 FR 61916; October 26, 1979.
68—44 FR 61920; October 26, 1979.
69—44 FR 61924; October 26, 1979.
70—44 FR 61927; October 26, 1979.
71—44 FR 61929; October 26, 1979.
72—44 FR 62246; October 26, 1979.
73—44 FR 62469; October 30, 1979.
74—44 FR 62471; October 30, 1979.
75—44 FR 62474; October 30, 1979.
76—44 FR 64247; November 6, 1979.
77—44 FR 64250; November 6, 1979.
78—44 FR 64252; November 6, 1979.
79—44 FR 64733; November 7, 1979.
80—44 FR 64738; November 7, 1979.
81—44 FR 64740; November 7, 1979.
82—44 FR 64743; November 7, 1979.
83—44 FR 64746; November 7, 1979.
84—44 FR 65005; November 8, 1979.
89—45 FR 18929; March 24, 1980.

[FR Doc. 80-15198 Filed 5-19-80; 8:45 am]

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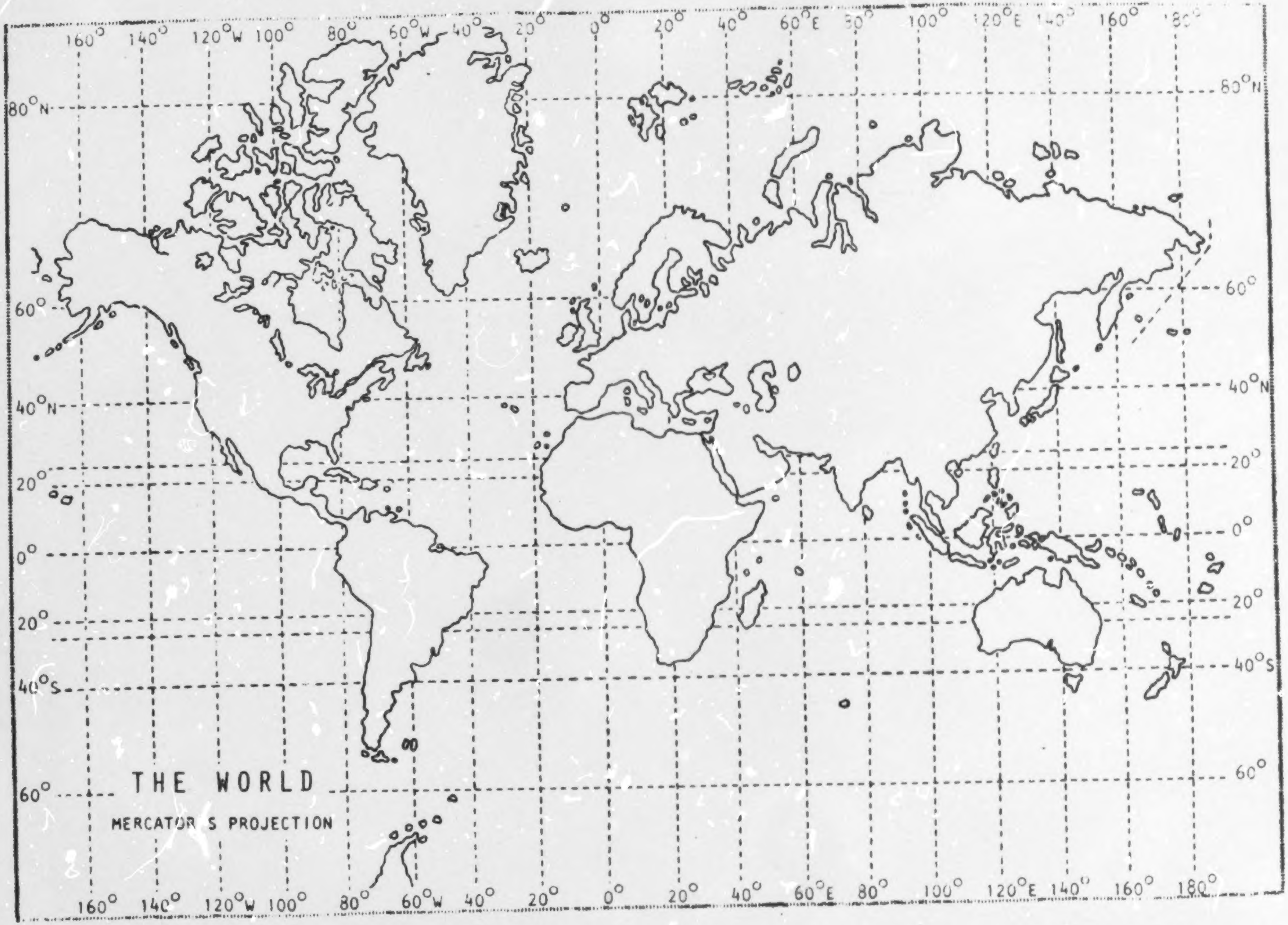
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Chapter 11
Activity Sheets

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX C-3755
SEATTLE, WASHINGTON 98124

NPPND-RF-1

14 April 1980

PUBLIC NOTICE

RECEIVED
APR 18 1980

Expiration Date: 14 May 1980
Reference No: 071-OYA-4-003538
(Winchester Creek-Fill)

Interested parties are hereby notified that application has been received for Department of the Army permit to perform certain work in navigable waters of this Engineer District.

Applicable Statutory Authority or Authorities:

( ) Perform work in or affecting navigable waters of the United States, upon the recommendation of the Chief of Engineers, pursuant to Section 10 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. 403):

( ) Discharge dredged or fill material into waters of the United States, upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 404 of the Clean Water Act of 1977 (P.L. 95-217):

( ) Transport dredged material for the purpose of dumping it into ocean water upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (86 Stat. 1052; P.L. 92-532):

Applicant: Winchester Bay Development Co.
545 - 12th Street
Reedsport, Oregon 97467

Location of Work: Winchester Creek, Mile 0.5, in Douglas County, at Winchester Bay, Oregon.

Description of Work: Placement of approximately 40,000 cubic yards of sand on approximately 15.5 acres of land, and placement of approximately 20 cubic yards of riprap at the end of a storm outfall pipe as shown on the attached drawings marked 003538 (Winchester Creek - Fill). Approximately 8.5 acres of the abovementioned land is an adjacent wetland of Winchester Creek and is the only portion of the project which is under the jurisdiction of the Corps of Engineers. Approximately 30,000 cubic yards of sand will be required to fill the wetland to construction grade of +10 feet Mean Lower Low Water. The sand will be trucked in from an upland source and distributed with cat and grader. The applicant states that the sand will be obtained from a hillside excavation site across the road from the fill site.

Purpose and Intended Use: To place fill for the purpose of constructing a mobile home park.

Additional Information: Additional information may be obtained from Duane L. Scroggins, BHW Engineering and Surveying, Inc., 1205 S.E. Court, Roseburg, Oregon 97470, telephone (503) 673-0165, or Ron Marg, Permit Coordinator, U.S. Army Corps of Engineers, P.O. Box 2946, Portland, Oregon 97208, telephone (503) 221-6995.

Special Conditions: The requested permit, if issued, will be the subject in part to the following conditions:

a. Slope of riprap, bank, or excavation, etc., will be no steeper than 1-½ foot horizontal to 1 foot vertical.

b. Only clean, durable riprap will be used.

c. All areas along the bank disturbed or newly created by the construction activity will be seeded, sodded, revegetated, or given some other equivalent type of protection against subsequent erosion.

d. Work in the waterway will be done so as to minimize turbidity increases in the water, which tend to degrade water quality and damage aquatic life.

e. When the District Engineer has been notified by a fishery agency that a filling activity is adversely affecting fish or wildlife resources or the harvest thereof, and when the District Engineer subsequently directs remedial measures, the permittee will comply with such directions as may be received to suspend or modify the activity, to the extent required to mitigate or eliminate the adverse effect.

Water Quality Certification: A permit for the described work will not be issued until certification, as required under Section 401 of the Clean Water Act of 1977 (P.L. 95-217), has been received from the certifying state.

Public Hearing: Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

Section 404(b) Evaluation: The impact of the activity on the public interest will be evaluated by EPA guidelines, under authority of Section 404(b) of the Clean Water Act.

Coastal Zone Management Act Certification: Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended by 16 USC 1456(c)(3), requires certification that the described activity affecting land or water uses in the Coastal Zone complies with the applicable State Coastal Zone Management Program. Attached to this Public Notice is a notice of application for Certification of Consistency for the applicable State Coastal Zone Management Program.

Endangered Species: Preliminarily, the described activity will not affect an endangered species, or their critical habitat designated as endangered or threatened, pursuant to the Endangered Species Act of 1973 (87 Stat. 844). Formal consultation pursuant to Section 7 of the Act with the Department of the Interior is not required for the described activity.

Floodplain Management: Evaluation of the proposed activity will include: conformance with appropriate State or local floodplain standards; consideration of alternative sites and methods o accomplishment; and weighing of the positive, concentrated and dispersed, and short- and long-term impacts on the floodplain.

Cultural Resources: The property described is not a registered property in the latest published version of the National Register of Historic Places, nor is it eligible for inclusion in the Register. This District is not aware of the presence of any cultural resources at the described worksite.

Environmental Impact Statement Determination: A preliminary determination has been made that an Environmental Impact Statement is not currently required for the described work.

Public Interest Review: The decision whether to issue a permit will be based upon an evaluation of the probable impact of the described activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered; among these are conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production, and in general, the needs and welfare of the people.

Additional Requirements: State law requires that leases, easements, or permits be obtained for certain works or activity in the described waters. These State requirements must be met, where applicable, and a Department of the Army permit must be obtained before any work within the applicable Statutory Authority, previously indicated, may be accomplished. Other local governmental agencies may also have ordinances or requirements which must be satisfied before the work is accomplished.

Comments on the described work should reach this office not later than expiration date of this Public Notice.

A. J. HEINEMAN
Chief, Navigation Division

11-3

ROBERT W. STRAUB
GOVERNOR

Department of Land Conservation and Development

1175 COURT STREET N.E., SALEM, OREGON 97310 PHONE (503) 378-4926

Notice of
Certification of Consistency with the
Oregon Coastal Management Program

Notice is hereby given that a certification has been filed with the Department of Land Conservation and Development, as provided in Section 307(c)(3) of the Coastal Zone Management Act, that the project described in the Corps of Engineers Public Notice No. 003538, will comply with the Oregon Coastal Management Program and that the project will be conducted in a manner consistent with that Program.

Any person desiring to present views or considerations pertaining to the project's compliance or consistency with the Oregon Coastal Management Program may do so by providing his views in writing to the Division of State Lands, 1445 State Street, Salem, OR 97310; within twenty days of publication of this notice.

REVIEW CRITERIA

Comments should address consistency with the applicable elements of Oregon's Coastal Management Program. These include:

- -Acknowledged Local Comprehensive Plans
- -Statewide Planning Goals
- -Fill and Removal Law (when a state permit is required)

ADEQUATE INFORMATION?

A copy of the applicant's consistency certification and information supporting the certification are available through the Department of Land Conservation and Development. If you believe additional information is needed to make a decision on this application, please indicate this as soon as possible. Requests for additional information must describe why more information is needed to make the consistency decision.

If following a written request the applicant fails to provide information needed to make a consistency decision, the permit may be found inconsistent.

INCONSISTENT?

If you believe this project is inconsistent with the Oregon Coastal Management Program, you should list the relevant policy (i.e., goal requirement or plan policy) and explain briefly why you believe the project is inconsistent. You should also describe how the project could be modified to make it consistent, if this is possible.

BC:ka/MC
12/26/78

7

Department of Environmental Quality

522 S.W. 5th AVENUE, P.O. BOX 1760, PORTLAND, OREGON 97207 PHONE (503) 229-5696

Victor Atiyeh
Governor

PUBLIC NOTICE

The following shall constitute public notice by the State of Oregon that the Department of Environmental Quality, pursuant to the requirements of Section 401 of the Clean Water Act of 1977, PL 95-217 has been requested to certify that there is reasonable assurance that the project described in Corps of Engineers Public Notice No. 071-OYA-4-003538 will not violate applicable water quality standards. Comments regarding possible water quality effects of the proposed project shall be sent within 30 days to the Department of Environmental Quality, P.O. Box 1760, Portland, Oregon 97207.

11-5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

MS 521

May 16, 1980

Mr. A. J. Heineman
Chief, Navigation Division
Portland District, C/E
P.O. Box 2946
Portland, Oregon 97208

RE: 071-OYA-4-003538, Winchester Bay Development Co., 4/14/80

Dear Mr. Heineman:

We have completed our review of the above referenced permit application. The proposed project includes the placement of 30,000 cubic yards of fill in approximately 8.5 acres of wetlands. The intended use of the proposed fill is for the construction of a mobile home park.

Our guidelines for evaluating Section 404 permit applications require that the discharge of fill material in a wetland shall not be permitted unless (1) the activity associated with the fill must have direct access or proximity to the water to fulfill its basic purpose, or other site or construction alternatives are not practicable, and: (2) the proposed fill and activity associated with it will not cause a permanent unacceptable disruption to the affected aquatic ecosystem. The proposed project does not meet any of these requirements.

A mobile home park does not require direct access or proximity to the water to fulfill its basic purpose and can be constructed on any reasonable upland building site. The proposed fill will permanently destroy approximately 8.5 acres of wetlands adjacent to Winchester Creek. Wetlands are very important components of the aquatic ecosystem and their destruction by filling operations is considered the most severe environmental impact covered by our guidelines. Therefore, we recommend that this permit be denied.

Sincerely,

Harold E. Geren, Chief
Permits Branch

CONCURRENCES

SYMBOL				Rlae				
SURNAME			Lond	Lee	Gren			
DATE				5/16				

EPA Form 1320-1 (12-70)

OFFICIAL FILE COPY

11-6

Salem, Oregon 97310
Phone: 378-3059

Date: April 17, 1980

WATERWAY PROJECT
PERMIT REVIEW

Corps Public Notice No. 071-OYA-4-003538 Div. of State Lands No. FP 3201

Applicant: Winchester Bay Development Company

Please return your comments to the Division of State Lands by: May 8, 1980

Application involves: (✓) Coastal Zone (✓) Fill (✓) Riprap

( ) Lease ( ) Easement ( ) Removal ( ) Structure

We have reviewed the above Corps Notice/Permit Application and offer the following comments:

( ) A __________ permit is required by this agency.

( ) We do not believe the project would have an adverse effect.

( ) We believe the effects of this project, although measurable, would be acceptable.

( ) We believe the project would be acceptable if methods of construction were altered as listed below.

(X) We would attend a conference with the applicant to seek project alternatives.

(X) The project is unacceptable as proposed (explained).

( ) We have no comment.

Comments:

The proposed project is not consistent with, nor meets the requirements of:

1) LCDC Goal 16
2) LCDC Goal 17
3) DSL fill/removal law
4) 404 (b)(1) Guidelines
5) Intent of Executive Order 11990

A letter explaining our departments position will follow.

RECEIVED
APR 28 1980
PERMITS BRANCH
EPA-REGION 10

Agency DFW By Date 4/25/80

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Environmental & Technical
Services Division
P.O. Box 4332, Portland, OR 97208

May 9, 1980 F/NWR5:ROF

Colonel Terence J. Connell
District Engineer, Portland District
Corps of Engineers
P.O. Box 2946
Portland, OR 97208

Re: P.N. #071-OYA-4-003538, Winchester Bay Development Co. (4-14-80)

Dear Colonel Connell:

We have initiated our review of the above public notice proposing the development of a mobile home park adjacent to Winchester Creek, at Winchester Bay, Oregon. The proposal includes 40,000 cubic yards of sand fill, and 20 cubic yards of riprap. About 30,000 cubic yards of the fill is planned for a wetland portion of approximately 8.5 acres in size.

The project as proposed does not appear to meet requirements of Section 404(b)(1) guidelines and Goals 16 and 17 of the Land Conservation and Development Commission Coastal Management Program.

Preliminary discussion with other agencies indicates that project alternatives will be sought. We request that this notice be held in abeyance until the possible alternatives have been discussed with other resource agencies and the applicant.

Sincerely yours,

Robert J. Pearce
for Dale R. Evans
Division Chief

cc: Oregon Department of Fish and Wildlife
Fish and Wildlife Service, ES, Portland
Environmental Protection Agency
Division of State Lands
Winchester Bay Development Co.

11-8

United States Department of the Interior

Division of Ecological Services
Portland Field Office
727 N.E. 24th Avenue
Portland, Oregon 97232

Reference: FS

May 13, 1980

Colonel Terence J. Connell, District Engineer
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear Colonel Connell:

The Fish and Wildlife Service has reviewed the following public notice:

Notice No./Date	Applicant Name	Due Date
071-OYA-4-003538 4/14	Winchester Bay Development Co.	5/14/80

Type of Permit: Section 404 of the Clean Water Act of 1977
(P.L. 95-217)

This Department requests that issuance of the permit be held in abeyance until we have had the opportunity to provide comments based on information obtained from forthcoming investigations of the project area.

Our comments on the application will be expedited upon completion of our investigations.

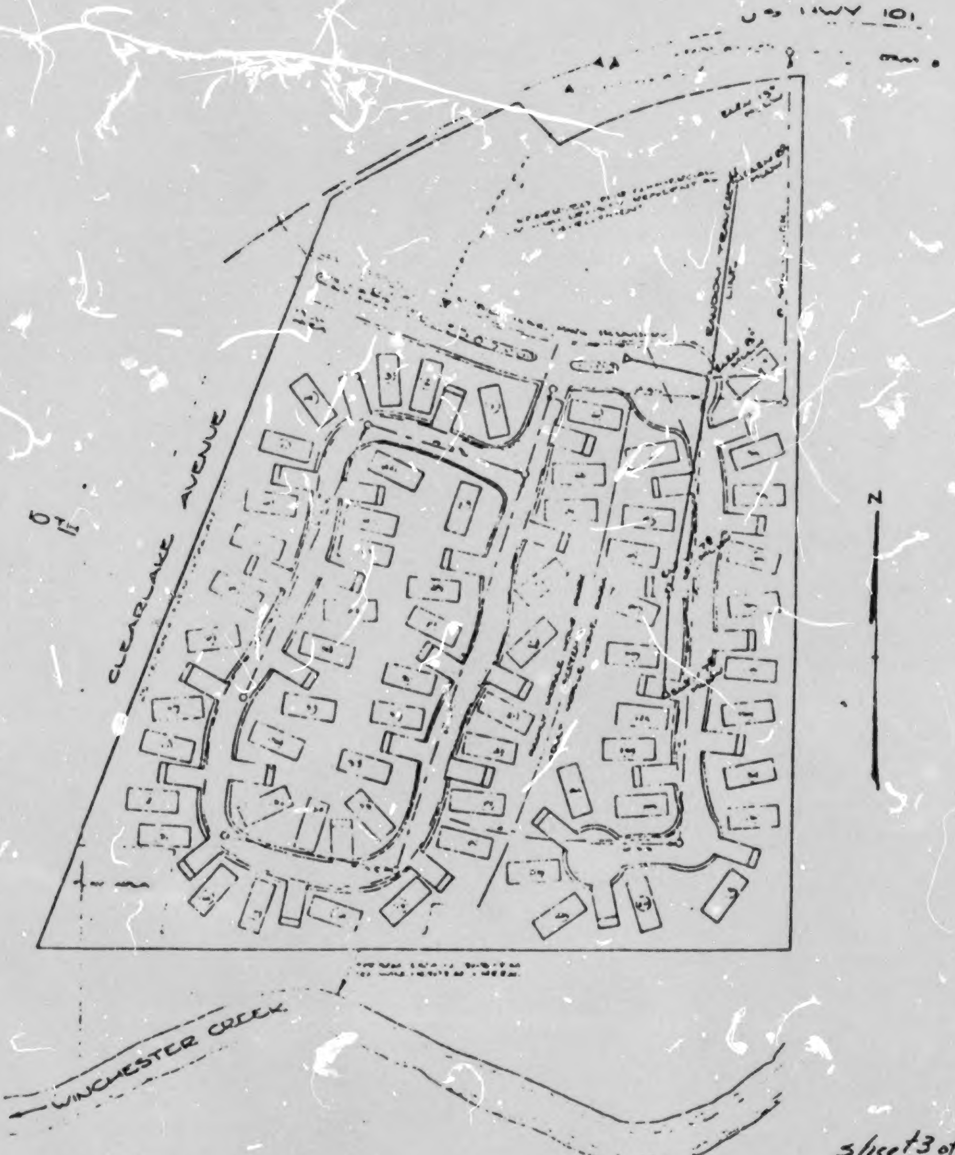
Sincerely yours,

Elmer F. Polz

for Roger E. Vorderstrasse
Acting Field Supervisor
Acting for U.S. Department
of the Interior
Coordinator

cc:
EPA ODFW
NMFS DEQ
DSL

11-9


U.S. HWY 101
CLEARLAKE AVENUE
6TH
N
WINCHESTER CREEK

SITE PLAN

sheet 3 of 3

Proposed Fill

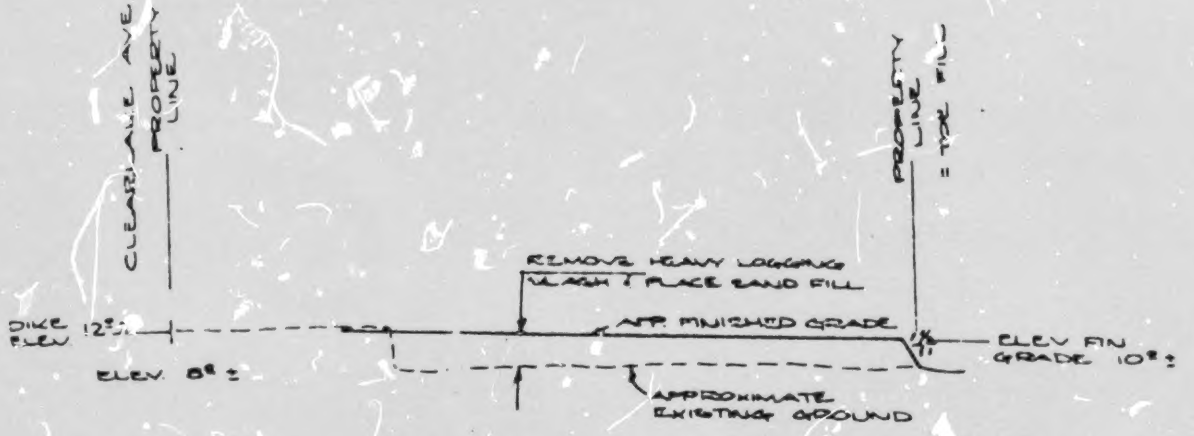
in Winchester Creek

at Mile 0.5

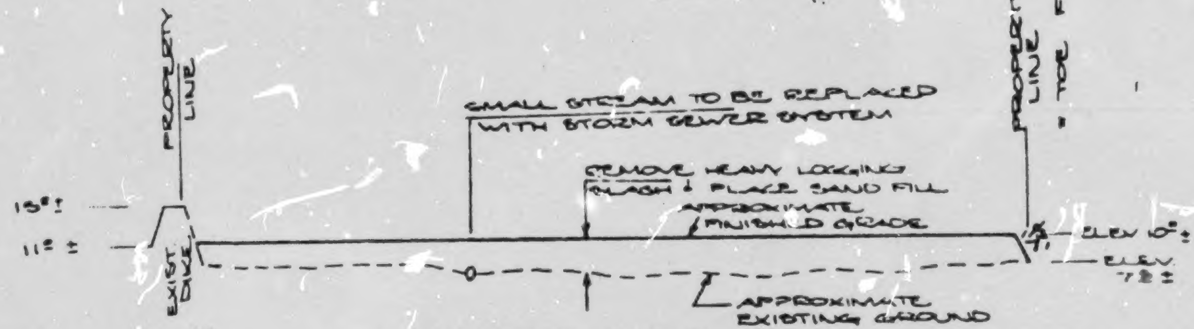
County of Douglas, State

Application by Winchester Bay Development Company

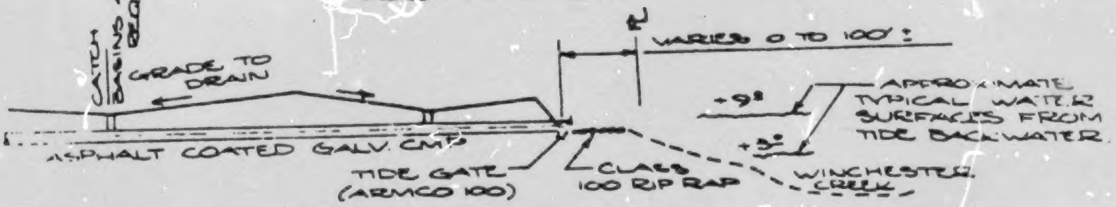
Date 7 January 1980


CLEARLAKE AVE PROPERTY LINE
PROPERTY LINE = TOE FILL
REMOVE HEAVY LOGGING SLASH & PLACE SAND FILL
DIKE ELEV. 12'±
APP. FINISHED GRADE
ELEV FIN GRADE 10'±
ELEV. 8'±
APPROXIMATE EXISTING GROUND

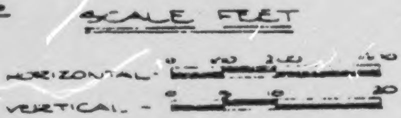
SECTION A.A.


PROPERTY LINE
PROPERTY LINE = TOE FILL
SMALL STREAM TO BE REPLACED WITH STORM SEWER SYSTEM
REMOVE HEAVY LOGGING SLASH & PLACE SAND FILL
APPROXIMATE FINISHED GRADE
15'±
11'±
EXIST. DIKE
ELEV 10'±
ELEV. 7'±
APPROXIMATE EXISTING GROUND

SECTION B.B.


CATCH BASINS AS REQ'D
GRADE TO DRAIN
VARIES 0 TO 100'±
+9'
+5'
APPROXIMATE TYPICAL WATER SURFACES FROM TIDE BACKWATER
ASPHALT COATED GALV. CMP
TIDE GATE (ARMCO 100)
CLASS 100 RIP RAP
WINCHESTER CREEK

SECTION C.C.
PROPOSED STORM SEWER
OUTFALL


SCALE FEET
HORIZONTAL
0
100
200
400
VERTICAL
0
5
10
20

NOTE:
STORM WATER SHALL BE IN AN ENGINEERED SYSTEM OF STREETS AND UTILITIES AS PART OF A MOBILE HOME PARK AND EXTEND FROM A SMALL CULVERT UNDER U.S. HWY. 101 TO WINCHESTER CREEK. FLAT GRADES RESULT IN LOW VELOCITY.

Proposed Fill

In Winchester Creek

at Mile 0.5

County of Douglas, State

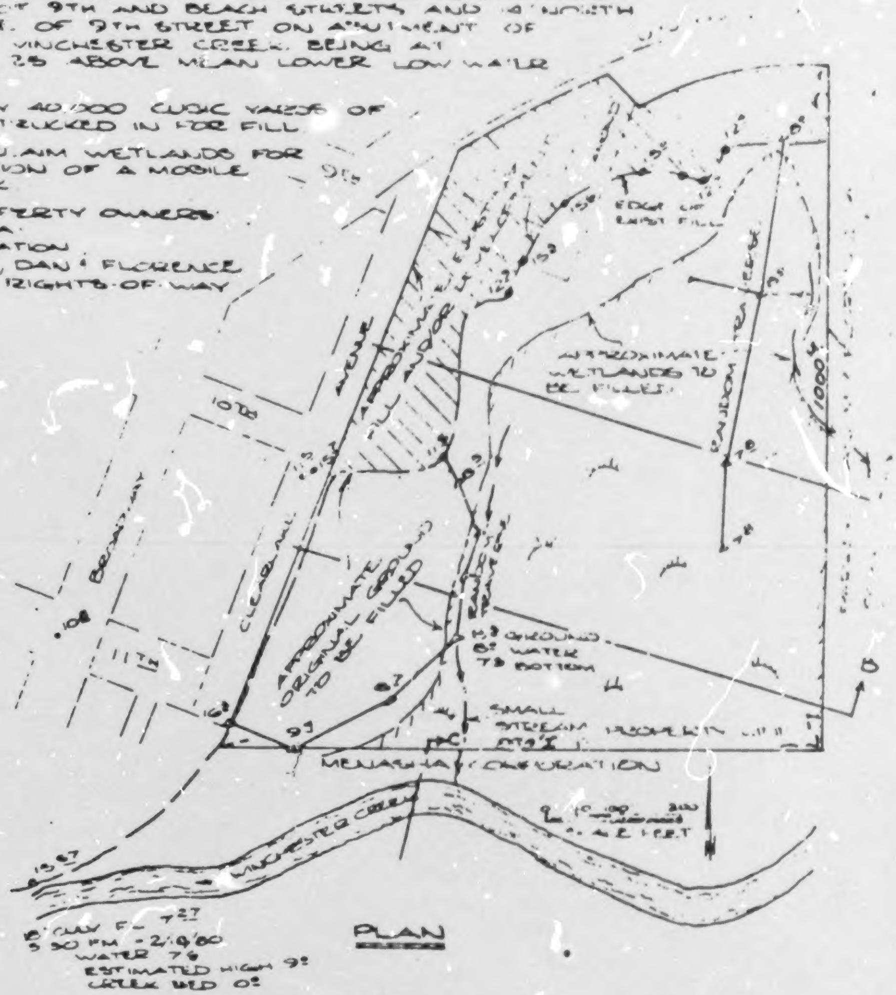
Application Winchester Bay Develop. Company

Date 7 January 1980

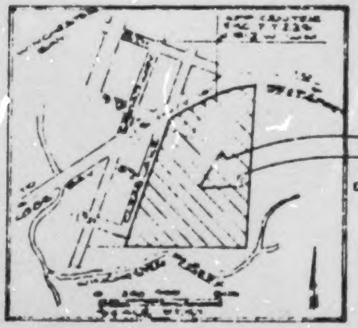
Sheet 2 of 3

NOTES:

1. ELEVATIONS SHOWN ON RECONNAISSANCE SURVEY ARE BASED ON BM 2 1975 ON CONCRETE BRIDGE 370' WEST OF THE CENTERLINE INTERSECTION OF 9TH AND BEACH STREETS AND 4' NORTH OF CENTERLINE OF 9TH STREET ON ABUTMENT OF BRIDGE OVER WINCHESTER CREEK. BEING AT ELEVATION 16.25 ABOVE MEAN LOWER LOW WATER (MLLW)
2. APPROXIMATELY 40,000 CUBIC YARDS OF SAND TO BE TRUCKED IN FOR FILL
3. PURPOSE: RECLAIM WETLANDS FOR CONSTRUCTION OF A MOBILE HOME PARK
4. ABUTTING PROPERTY OWNERS:
   - A) MENASHA CORPORATION
   - B) PARKER, DAN & FLORENCE
   - C) PUBLIC RIGHTS-OF-WAY


10TH
AVENUE
BROADWAY
CLEVELAND
11TH
APPROXIMATE EXIST FILL AND/OR
EDGE OF EXIST FILL
APPROXIMATE WETLANDS TO BE FILLED
RANDOM TRAVERSE
1000'±
APPROXIMATE ORIGINAL GROUND TO BE FILLED
11.3 GROUND
8.2 WATER
7.3 BOTTOM
SMALL STREAM
PROPERTY LINE
MENASHA CORPORATION
WINCHESTER CREEK
0 100 200
SCALE FEET
13.67
15' CLAY F— 7.27
3:30 PM - 2/9/80
WATER 7.6
ESTIMATED HIGH 9.0
CREEK BED 0.0

PLAN



VICINITY MAP

DOUGLAS COUNTY ASSESSORS ACCOUNT NUMBERS

3126
21147
21262 - 21270
21276 - 21290

Long. 124° 10' 25"
Lat. 43° 40' 25"

sheet 1 of 3

Proposed Fill

In Winchester Creek

at Mile 0.5

County of Douglas , Stat

Application by Winchester Bay Devel ment Company

Date 7 January 1980

11-12

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX C-3755
SEATTLE, WASHINGTON 98124

NPSOP-RF 11 February 1980

PUBLIC NOTICE

RECEIVED
FEB 13 1980

Reference: 071-CYB-4-006264
Puget Sound Power and
Light Company

Application has been received from Puget Sound Power and Light Company, Puget Power Building, Bellevue, Washington 98009 (ATTN: W. J. Finnegan, Director, Conservation and Environmental Affairs, Telephone (206) 454-6363) for Department of the Army permit in accordance with Section 404 of the Clean Water Act for certain work described below and shown on the inclosed prints.

PROPOSED WORK:

a. Location: On wetland adjacent to Mercer Slough, at Bellevue, Washington.

b. Physical Character: Place wet concrete (support structures) and temporary fill (road embankment).

c. Purpose (as explained by the applicant): Build 115KV transmission line.

The State of Washington is reviewing this work for consistency with the approved Washington Coastal Zone Management Program.

The evaluation of the impact of the activity on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act.

Preliminary review by the Seattle District indicates that this work will not significantly affect the quality of the human environment. The preparation of a Federal Environmental Impact Statement is not anticipated at this time.

Preliminary determinations indicate that the activity will not affect endangered species, or their critical habitat, designed as endangered or threatened pursuant to the Endangered Species Act of 1973 (87 Stat. 844). Formal consultation pursuant to Section 7 of the Act with the Department of the Interior is not required for this activity.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

11-13

071-OYB-4-006264

Presently unknown archeological, scientific, prehistorical or historical data may be lost or destroyed by work to be accomplished under the requested permit. The work is not located on a property registered in the National Register of Historic Places.

The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity on the public interest. That decision will reflect the national concern for boty protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered; among those are conservation, economics, esthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people.

Comments on these factors will be accepted and made part of the record and will be considered in determining whether it would be in the best public interest to grant a permit. Comments should refer to the reference number shown above and reach this office, Attn: Permit Section, not later than 12 March 1980 to insure consideration.

1 Incl
Prints (2)

11-14

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Environmental & Technical Services Division
P.O. Box 4332, Portland, OR 97208

March 4, 1980 F/NWR5:CES

RECEIVED
MAR 7 1980

Colonel Leon K. Moraski
District Engineer, Seattle District
Corps of Engineers
P.O. Box C-3755
Seattle, WA 97124

Re: 071-OYB-4-006264, Puget Sound Power and Light Company (2-11-80)

Dear Colonel Moraski:

We have reviewed the information provided in the referenced public notice and have discussed the project with other agencies. We believe the power transmitted in the proposed lines to be in the interest of the general public. We therefore will not object to a permit for the supporting towers.

The proposed roadway, 22 feet wide at the base and 1100 feet long, would cover more than half an acre of important Lake Washington wetlands. We believe the large amount of hog fuel on the wetlands for the construction access road would be virtually impossible to remove without destroying the substrate. We therefore recommend that in lieu of the temporary fill as proposed that timber mats be laid down across the marsh to the various construction sites. These mats would be easier to remove and less damaging to the environment in the long run.

If you have any questions concerning our comments and recommendations you may contact Clifford Soderstrom of this office (503) 234-3361, ext. 4311 or on FTS 429-4311.

Sincerely yours,

Dale R. Evans
Division Chief

cc: Washington Department of Fisheries
Washington Department of Game
Department of Ecology - Shara Stelling
✓Environmental Protection Agency - Seattle MS-521
Fish and Wildlife Service, ES, Olympia
Puget Sound Power & Light Company, W. J. Finnegan

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Environmental & Technical Services Division
P.O. Box 4332, Portland, OR 97208

March 4, 1980 F/NWR5:CES

RECEIVED
MAR 7 1980

Colonel Leon K. Moraski
District Engineer, Seattle District
Corps of Engineers
P.O. Box C-3755
Seattle, WA 97124

Re: 071-OYB-4-006264, Puget Sound Power and Light Company (2-11-80)

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If you have any questions concerning our comments and recommendations you may contact Clifford Soderstrom of this office (503) 234-3361, ext. 4311 or on FTS 429-4311.

Sincerely yours,

Dale R. Evans
Division Chief

cc: Washington Department of Fisheries
Washington Department of Game
Department of Ecology - Shara Stelling
✓Environmental Protection Agency -- Seattle MS-521
Fish and Wildlife Service, ES, Olympia
Puget Sound Power & Light Company, W. J. Finnegan

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

District Engineer
Seattle District, C/E
ATTN: Chief, Reg. Func. Branch
P.O. Box C-3755
Seattle, WA 98124

Ref: 071-OYB-4-006264 Puget Sound Power & Light Co., 11 February 1980

Dear Sir:

We have received the above referenced permit application to construct a temporary road along Mercer Slough.

An on site inspection has indicated that the proposed project will seriously impact a productive wetland area. As required by our Section 404 guidelines, we must consider all feasible alternatives when reviewing a project of this nature. The purpose of this review is to protect wetlands from unnecessary or avoidable impacts. These guidelines state that the applicant must demonstrate that alternatives having less impact on the environment do not exist. Accordingly, we ask that this permit be held in abeyance until the applicant can demonstrate a lack of feasible alternatives.

Sincerely,

George Abel, Chief
Dredge and Fill Permits Section

cc: USFWS
NMFS
WDE

PLEA: ComCentr:jn:3/26/80

CONCURRENCES

SYMBOL								
SURNAME								
DATE								

STATE OF
WASHINGTON

Dixy Lee Ray
Governor

DEPARTMENT OF ECOLOGY
Olympia, Washington 98504 206/753 2800

Mail Stop PV-11

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

11 February 1980

Notice of Application for Water Quality Certification and for Certification of Consistency with the Washington Coastal Zone Management Program

Notice is hereby given that a request is being filed with the Department of Ecology for certification, as provided in Section 401 of the Federal Water Pollution Control Act, that a proposed dischange to navigable waters, resulting from the project described in the Corps of Engineers Public Notice No. 071-OY8-4-006264, will comply with the applicable provisions of the Federal Water Pollution Control Act.

Notice is also given that a request is being filed with the Department of Ecology for concurrence, as provided in Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended (P.L. 94-370; 90 Stat. 1013; 16 U.S.C. 1456(c)(3), that the above described project will comply with the Washington Coastal Zone Management Program and that the project will be conducted in a manner consistent with that Program.

Any person desiring to present views on either or both (1) water pollution considerations pertaining to the project or (2) considerations pertaining to the project's compliance or consistency with the Washington Coastal Zone Management Program may do so by providing his views in writing to the Department of Ecology, ATTN: Interagency Operations Section, Olympia, Washington 98504, within 20 days of publication of this notice.

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX C-3755
SEATTLE, WASHINGTON 98124

NPSOP-RF

27 May 1980

PUBLIC NOTICE

RECEIVED
[illegible] 1980

Reference: 071-OYB-4-006264-R
Puget Sound Power
and Light Company

REVISED

Application has been received from Puget Sound Power and Light Company, Puget Power Building, Bellevue, Washington 98009 (ATTN: W. J. Finnegan, Director, Conservation and Environmental Affairs, Telephone (206) 454-6363) for Department of the Army permit in accordance with Section 404 of the Clean Water Act for certain work described below and shown on the inclosed prints. This application was previously advertised under the same number on 11 February 1980. The revision consists of deleting the access road and substituting a temporary hog-fuel mat.

PROPOSED WORK:

a. Location: On wetlands adjacent to Mercer Slough at Bellevue, Washington.

b. Physical Character: Place wet concrete (support structure) and temporary fill (barge staging area).

c. Purpose (as explained by the applicant): Build 115KV transmission line.

The State of Washington is reviewing this work for consistency with the approved Washington Coastal Zone Management Program.

The evaluation of the impact of the activity on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act.

Preliminary review by the Seattle District indicates that this work will not significantly affect the quality of the human environment. The preparation of a Federal Environmental Impact Statement is not anticipated at this time.

Preliminary determinations indicate that the activity will not affect endangered species, or their critical habitat, designated as endangered or threatened pursuant to the Endangered Species Act of 1973 (87 Stat. 844). Formal consultation pursuant to Section 7 of the Act with the Department of the Interior is not required for this activity.

071-OYB-4-006264

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

Presently unknown archeological, scientific, prehistorical or historical data may be lost or destroyed by work to be accomplished under the requested permit. The work is not on a property registered in the National Register of Historic Places.

The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered; among those are conservation, economics, esthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production, and, in general, the needs and welfare of the people.

Comments on these factors will be accepted and made part of the record and will be considered in determining whether it would be in the best public interest to grant a permit. Comments should refer to the reference number shown above and reach this office, Attn: Permit Section, not later than 26 June 1980 to insure consideration.

1 Incl
Prints (2)

11-20

MARCH 3, 1849

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
2625 Parkmont Lane, S.W., Bldg B-3
Olympia, WA 98502

RECEIVED
JUN 18 1980

June 12, 1980

Colonel Leon K. Moraski
District Engineer
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Colonel Moraski:

The U.S. Fish and Wildlife Service has reviewed the project plans described in the following public notices and has no objection to the issuance of the appropriate permits:

NR-79-1	Commanding Officer, Naval Submarine Base, Bangor, Bremerton, WA	5-23-80
071-OYB-2-003822-R	Tacoma, City of	6-4-80
071-OYB-2-006638	Tacoma, City of	5-30-80
071-OYB-2-006488	Tostevin, Bob	4-28-80
071-OYB-1-006588	Wash. St. Dept. of Nat. Resources	6-5-80
071-OYB-2-006527	Hamon, Charles B.	5-7-80
071-OYB-1-004364	Cartmell, Herman H.	6-5-80
071-OYB-1-006369	Crown Zellerbach Corporation	3-19-80
071-OYB-1-006617	Lindsey, James M. and June F.	6-4-80
071-OYB-1-006576	Wash. St. Dept. of Transportation	5-29-80
071-OYB-1-006574	Wallace, Dr. Marvin	5-29-80
071-OYB-1-006485	Madigan, Dan	5-27-80
071-OYB-1-006545	Rice, Marshall	5-27-80
071-OYB-2-006502	King County Arts Commission	5-27-80
071-OYB-1-006575	McDonald, Kirby	5-28-80
071-OYB-1-006549	Adams, James E.	5-21-80
071-OYB-1-006553	Behar, E. D.	5-22-80
071-OYB-2-006029	Merritt, Bert F.	5-29-80
071-OYB-4-006264	Puget Sound Power and Light Co.	5-27-80
071-OYB-2-006470	Abbott, Clafos	4-25-80

In the event that cumulative effects of individual projects begin to adversely impact fish and wildlife resources, we may reassess our position and recommend denial of future permit applications for similar projects in these areas.

Sincerely,

R. G. Starkey

R. G. Starkey
Acting Field Supervisor for U.S. Department of the Interior Coordinator
cc: WDE, WDF, WDG, EPA, NMFS, BIA

11-21 224

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Mail Stop 521

District Engineer
Seattle District, C/E
Attn: Reg. Func. Br.
P.O. Box C-3755
Seattle, Washington 98124

Dear Sir:

The Environmental Protection Agency, Region 10, has no objection to the issuance of permits for the projects which are described in the following public notices:

RE: 071-OYB-2-006013-R, Dick Talcott, 11 June 80
071-OYB-2-005317-R, Kester Brothers, Inc., 5 June 80
071-OYB-2-006533, Seamount Estates, 3 June 80
071-OYB-4-006264-R, Puget Sound Powers, 27 May 80
071-OYB-1-00-6619, Orcas Power and Light Company, and Inter-Island Telephone Company, 12 June 80

Sincerely,

Ronald A. Lee, Chief
Dredge & Fill Permits Section

cc: USFWS - Olympia
NMFS
WDE

11-22

STATE OF WASHINGTON
Dixy Lee Ray
Governor

DEPARTMENT OF ECOLOGY
Olympia, Washington 98504 206/753-2800

Mail Stop PV-11 27 May 1980

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Notice of Application for Water Quality Certification and for Certification of Consistency with the Washington Coastal Zone Management Program

Notice is hereby given that a request is being filed with the Department of Ecology for certification, as provided in Section 401 of the Federal Water Pollution Control Act, that a proposed discharge to navigable waters, resulting from the project described in the Corps of Engineers Public Notice No. 071-OYB-4-006264, will comply with the applicable provisions of the Federal Water Pollution Control Act.

Notice is also given that a request is being filed with the Department of Ecology for concurrence, as provided in Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended (P.L. 94-370; 90 Stat. 1013; 16 U.S.C. 1456(c)(3), that the above described project will comply with the Washington Coastal Zone Management Program and that the project will be conducted in a manner consistent with that Program.

Any person desiring to present views on either or both (1) water pollution considerations pertaining to the project or (2) considerations pertaining to the project's compliance and consistency with the Washington Coastal Zone Management Program may do so by providing his views in writing to the Department of Ecology, ATTN: Interagency Operations Section, Olympia, Washington 98504, within 20 days of publication of this notice.

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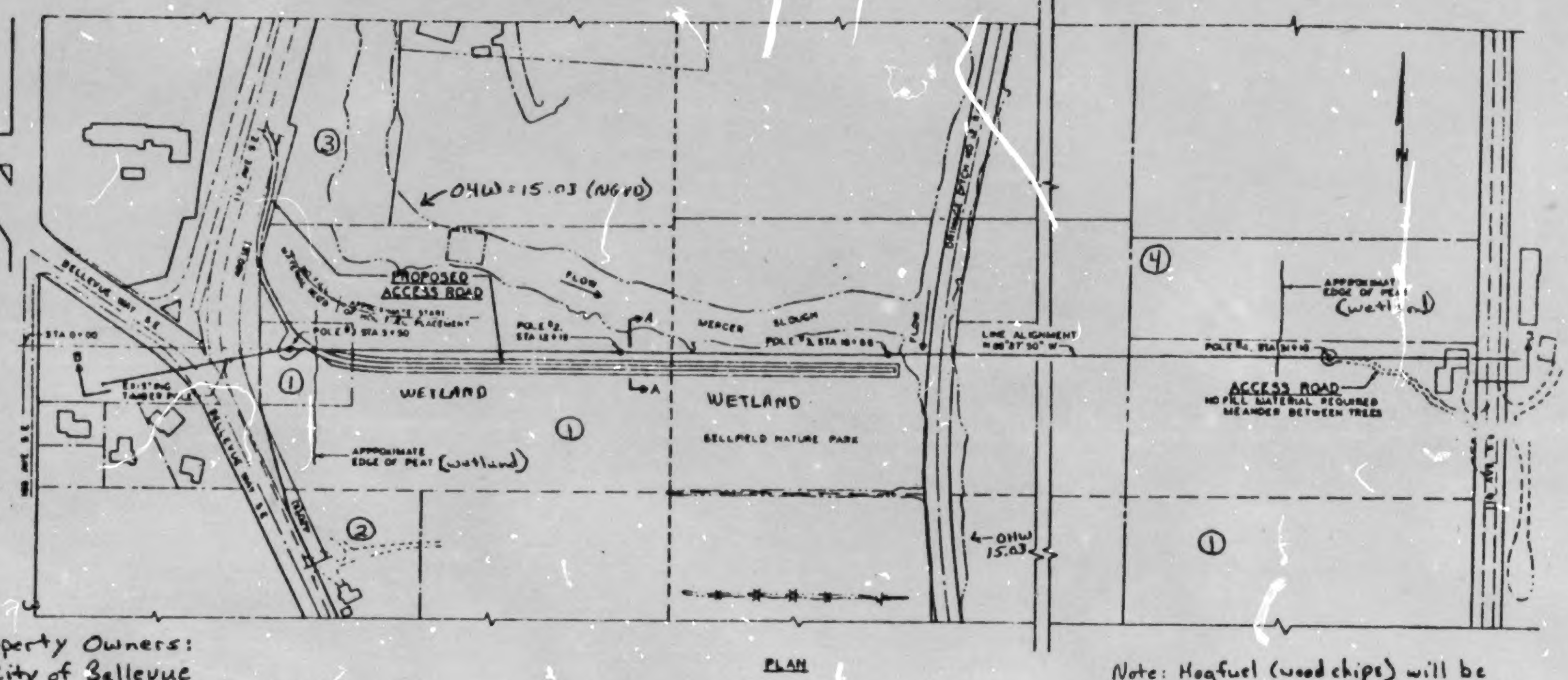
11-23

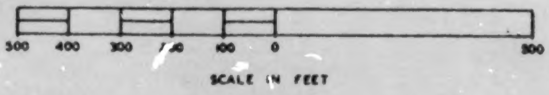
1124


OHW = 15.03 (NGVD)
③
PROPOSED ACCESS ROAD
FLOW
MERCER SLOUGH
POLE 1 STA 5+50
POLE 2 STA 12+19
POLE 3 STA 18+88
STA 0+00
EXISTING TANGENT POLE
BELLEVUE WAY S.E.
A
LINE ALIGNMENT
WETLAND
WETLAND
BELLFIELD NATURE PARK
①
①
APPROXIMATE EDGE OF PEAT (wetland)
②
4-OHW 15.03
④
APPROXIMATE EDGE OF PEAT (wetland)
ACCESS ROAD
NO FILL MATERIAL REQUIRED
MEANDER BETWEEN TREES
①
PLAN

Property Owners:
① City of Bellevue
② Zaser-Longston Inc.
③ Great Western
④ T.R. Moon + L.I. Ross

Note: Hogfuel (wood chips) will be disposed in non-wetland upland area in accordance with City of Bellevue direction.

Note: Hogfuel road will remain in place during construction for no more than 16 weeks. It will be removed within four weeks after construction of Line Sta. 5+50 - Sta 18+88. Total time in place = 20 weeks.

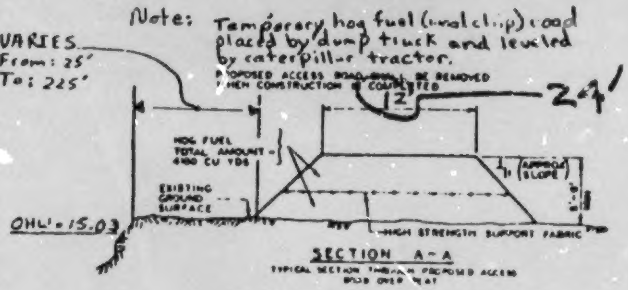

500
400
300
200
100
0
500
SCALE IN FEET

071-OYB-4-006264

PROPOSED OVERHEAD
TRANSMISSION LINE
AND TEMPORARY FILL
IN MERCER SLOUGH
AT BELLEVUE, WASHINGTON
COUNTY OF KING STATE OF WASHINGTON
APPLICATION BY PUGET SOUND POWER & LIGHT COMP.
SHEET 1 OF 2 12/28/79 REV: 1/23/

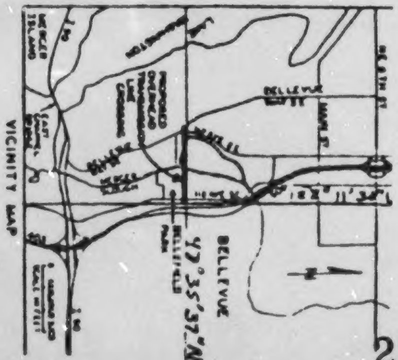
PURPOSE Temporary access road to build 115 KV Transmission line.
DATUM NATIONAL GEODETIC VERTICAL DATUM OF 1929

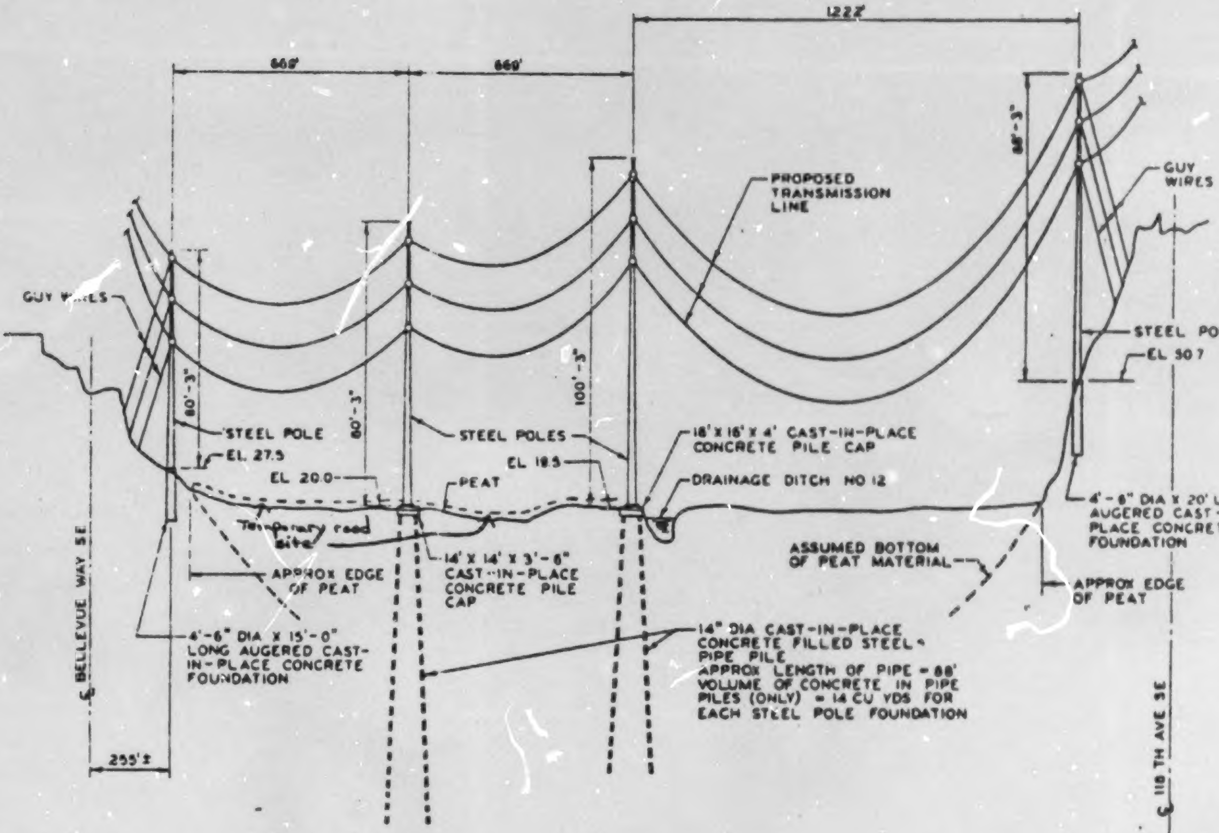
Note: Temporary hog fuel (wood chip) road placed by dump truck and leveled by caterpillar tractor.


VARIES
From: 25'
To: 225'
PROPOSED ACCESS ROAD WILL BE REMOVED WHEN CONSTRUCTION IS COMPLETED
12'
24'
HOG FUEL TOTAL AMOUNT 4100 CU YDS
APPROX SLOPE
EXISTING GROUND SURFACE
OHW = 15.03
HIGH STRENGTH SUPPORT FABRIC

SECTION A-A
TYPICAL SECTION THROUGH PROPOSED ACCESS ROAD OVER PEAT

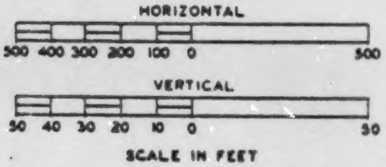
Length of road is 1,100 feet


VICINITY MAP
MERCER ISLAND
BELLEVUE
MERCER SLOUGH
BELLEFIELD PARK
PROPOSED OVERHEAD TRANSMISSION LINE
47°35'37"N
122°11'34"W
N



660'
660'
1222'
GUY WIRES
GUY WIRES
PROPOSED TRANSMISSION LINE
80'-3"
80'-3"
100'-3"
88'-3"
STEEL POLE
STEEL POLES
STEEL POLE
EL. 27.5
EL 20.0
EL 18.5
EL 30.7
PEAT
Temporary road site
18' X 16' X 4' CAST-IN-PLACE CONCRETE PILE CAP
DRAINAGE DITCH NO 12
14' X 14' X 3'-6" CAST-IN-PLACE CONCRETE PILE CAP
APPROX EDGE OF PEAT
ASSUMED BOTTOM OF PEAT MATERIAL
APPROX EDGE OF PEAT
4'-6" DIA X 15'-0" LONG AUGERED CAST-IN-PLACE CONCRETE FOUNDATION
4'-6" DIA X 20' LONG AUGERED CAST-IN-PLACE CONCRETE FOUNDATION
14" DIA CAST-IN-PLACE CONCRETE FILLED STEEL PIPE PILE
APPROX LENGTH OF PIPE = 88'
VOLUME OF CONCRETE IN PIPE PILES (ONLY) = 14 CU YDS FOR EACH STEEL POLE FOUNDATION
℄ BELLEVUE WAY SE
255'±
℄ 118 TH AVE SE

SECTION B - B



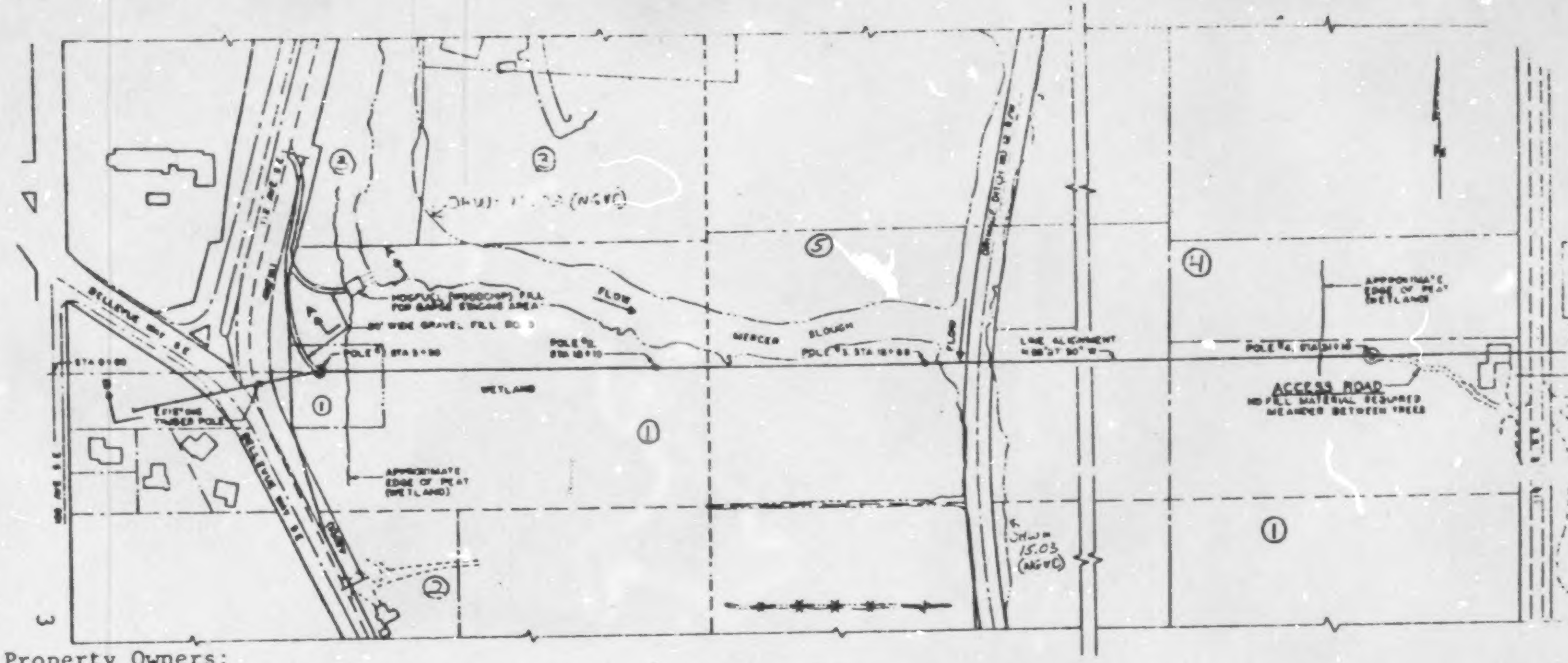
HORIZONTAL
500 400 300 200 100 0 500
VERTICAL
50 40 30 20 10 0 50
SCALE IN FEET

PURPOSE: BUILD 115KV TRANSMISSION LINE

DATUM NATIONAL GEODETIC VERTICAL DATUM OF 1929 OHW = 15.03

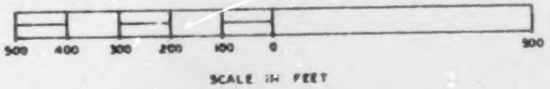
071-04B-4-006264

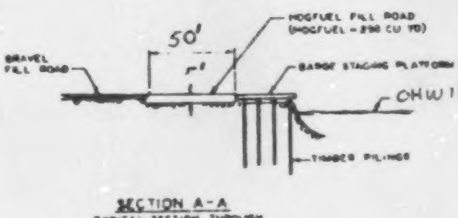
PROPOSED OVERHEAD TRANSMISSION LINE AND TEMPORARY FILL
IN MERCER SLOUGH
AT BELLEVUE, WASHINGTON
COUNTY OF KING STATE OF WASHINGTON
APPLICATION BY PUGET SOUND POWER & LIGHT CO
SHEET 2 OF 2 12/28/79 Rev: 1/23/80


BELLEVUE WAY SE
STA 0+00
EXISTING TIMBER POLE
POLE 1 STA 3+90
POLE 2 STA 10+10
POLE 3 STA 19+85
POLE 4 STA 31+
HOGFUEL (WOODCHIP) FILL FOR BARGE STAGING AREA
20' WIDE GRAVEL FILL ROAD
APPROXIMATE EDGE OF PEAT (WETLAND)
WETLAND
MERCER SLOUGH
FLOW
OHW 15.03 (NGVD)
LINE ALIGNMENT
ACCESS ROAD
HOGFUEL MATERIAL REQUIRED MEANDER BETWEEN TREES
①
②
③
④
⑤
3

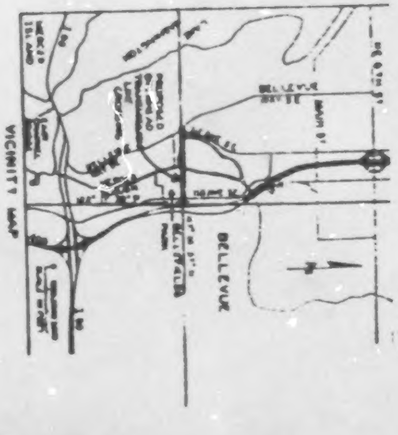
Property Owners:
1. City of Bellevue
2. Zaser-Longsten
3. Great Western
4. T. R. Moon & L. I. Ross
5. Mortgage Trust of America

PLAN


500
400
300
200
100
0
500
SCALE IN FEET


50'
GRAVEL FILL ROAD
HOGFUEL FILL ROAD (HOGFUEL – 290 CU YD)
BARGE STAGING PLATFORM
OHW 15.03'
TIMBER PILINGS

SECTION A-A
TYPICAL SECTION THROUGH PROPOSED HOGFUEL FILL ON WETLAND


NE 8TH ST
MAIN ST
BELLEVUE
PROPOSED OVERHEAD TRANSMISSION LINE CROSSING
MERCER ISLAND
I-90
VICINITY MAP

PURPOSE: TEMPORARY ACCESS FILL TO BUILD 115 KV TRANSMISSION LINE

DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929

NOTES:

1. TEMPORARY HOGFUEL FOR BARGE STAGING AREA WILL HAVE BASE DIMENSIONS OF 50' X 50' COVERING WETLAND SURFACE.
2. A WOOD PLATFORM WITH APPROXIMATE DIMENSIONS OF 20' X 30' WILL BE CONSTRUCTED ON PILINGS ADJACENT TO THE HOGFUEL FILL AND EXTENDING INTO THE WATERWAY
3. HOGFUEL WILL BE PLACED BY DUMPTRUCK AND LEVELED BY CAT TRACTOR
4. HOGFUEL WILL REMAIN IN PLACE APPROXIMATELY 12 WEEKS. IT WILL BE REMOVED BY EARTH MOVING MACHINE AND DISPOSED OF IN A NON-WETLAND UPLAND AREA IN ACCORDANCE WITH CITY OF BELLEVUE DIRECTION

Application No. 071-OYB-4-006264

PROPOSED OVERHEAD TRANSMISSION LINE AND TEMPORARY FILL

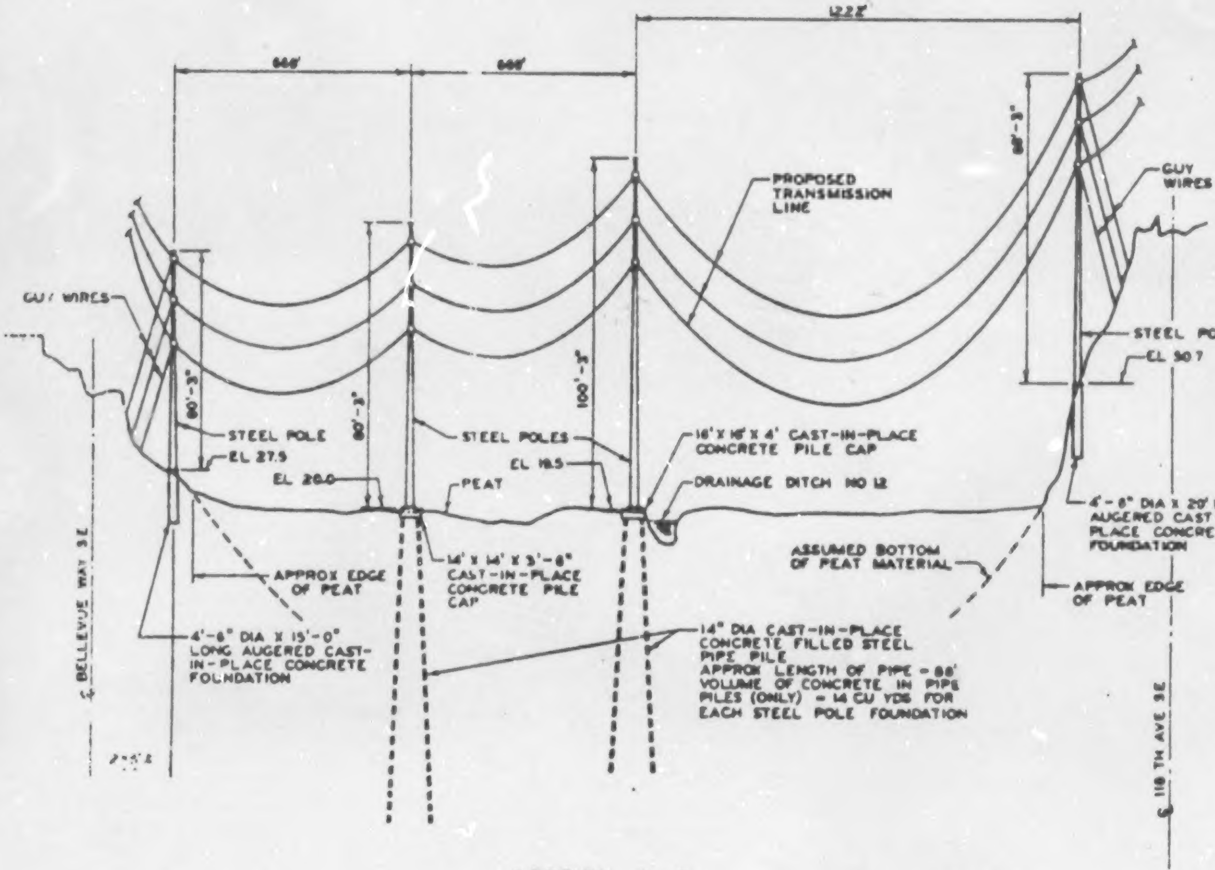
IN MERCER SLOUGH

AT BELLEVUE, WASHINGTON

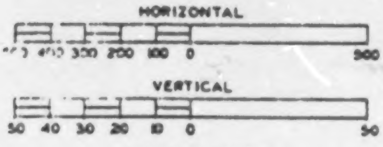
COUNTY OF KING STATE OF WASHINGTON

APPLICATION BY PUGET SOUND POWER & LIGHT COMPANY

SHEET 1 OF 2 12/28/77 Rev. 1/79
2nd Rev. 4/30/80


668'
668'
1222'
GUY WIRES
80'-3"
80'-3"
100'-3"
88'-3"
PROPOSED TRANSMISSION LINE
GUY WIRES
STEEL POLE
EL 27.5
EL 20.0
STEEL POLES
EL 18.5
PEAT
16' X 16' X 4' CAST-IN-PLACE CONCRETE PILE CAP
DRAINAGE DITCH NO 12
STEEL POLE
EL 30.7
4'-6" DIA X 20' LONG AUGERED CAST-IN-PLACE CONCRETE FOUNDATION
ASSUMED BOTTOM OF PEAT MATERIAL
APPROX EDGE OF PEAT
APPROX EDGE OF PEAT
14' X 14' X 3'-8" CAST-IN-PLACE CONCRETE PILE CAP
4'-6" DIA X 15'-0" LONG AUGERED CAST-IN-PLACE CONCRETE FOUNDATION
14" DIA CAST-IN-PLACE CONCRETE FILLED STEEL PIPE PILE
APPROX LENGTH OF PIPE - 88'
VOLUME OF CONCRETE IN PIPE PILES (ONLY) - 14 CU YDS FOR EACH STEEL POLE FOUNDATION
℄ BELLEVUE WAY SE
℄ 118 TH AVE SE

SECTION B - B


HORIZONTAL
500 400 300 200 100 0
500
VERTICAL
50 40 30 20 10 0
50

SCALE IN FEET

PURPOSE TEMPORARY ACCESS FILL TO BUILD
115 KV TRANSMISSION LINE
DATUM NATIONAL GEODETIC VERTICAL DATUM OF 1929 OHW = 15.03

Application No. 071-OYB-4-00626

PROPOSED OVERHEAD
TRANSMISSION LINE
AND TEMPORARY FILL

IN MERCER SLOUGH

AT BELLEVUE, WASHINGTON

COUNTY OF KING STATE OF WASHINGTON

APPLICATION BY PUGET SOUND POWER & LIGHT CO

SHEET 2 OF 2 12/28/79 Rev. 1/23/80
2nd Rev. 4/30/80

DEPARTMENT OF DEFENSE

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX C-3755
SEATTLE, WASHINGTON 98124

RECEIVED
JUN 25 1980

24 June 1980

PUBLIC NOTICE

Reference: 071-OYB-4-006602
North Mason School District
No. 403

Application has been received from North Mason School District No. 403 P.O. Box 167, Belfair, Washington 98528 (ATTN: Norman A. Sanders, Superintendent, telephone (206) 275-2881) for Department of the Army permit in accordance with Section 404 of the Clean Water Act for certain work described below and shown on the inclosed print.

PROPOSED WORK:

a. Location: Lynch Cove, Hood Canal, Puget Sound near Belfair, Mason County, Washington.

b. Physical Character: Place fill in wetlands.

c. Purpose (as explained by the applicant): School playground.

The State of Washington is reviewing this work for consistency with the approved Washington Coastal Zone Management Program.

The evaluation of the impact of the activity on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act.

Preliminary review by the Seattle District indicates that this work may significantly affect the quality of the human environment. The preparation of a Federal Environmental Impact Statement may be required.

Preliminary determinations indicate that the activity will not affect endangered species, or their critical habitat, designated as endangered or threatened pursuant to the Endangered Species Act of 1973 (87 Stat. 844). Formal consultation pursuant to Section 7 of the Act with the Department of the Interior is not required for this activity.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

Presently unknown archeological, scientific, prehistorical or historical data may be lost or destroyed by work to be accomplished under the requested permit. The work is not located on a property registered in the National Register of Historic Places.

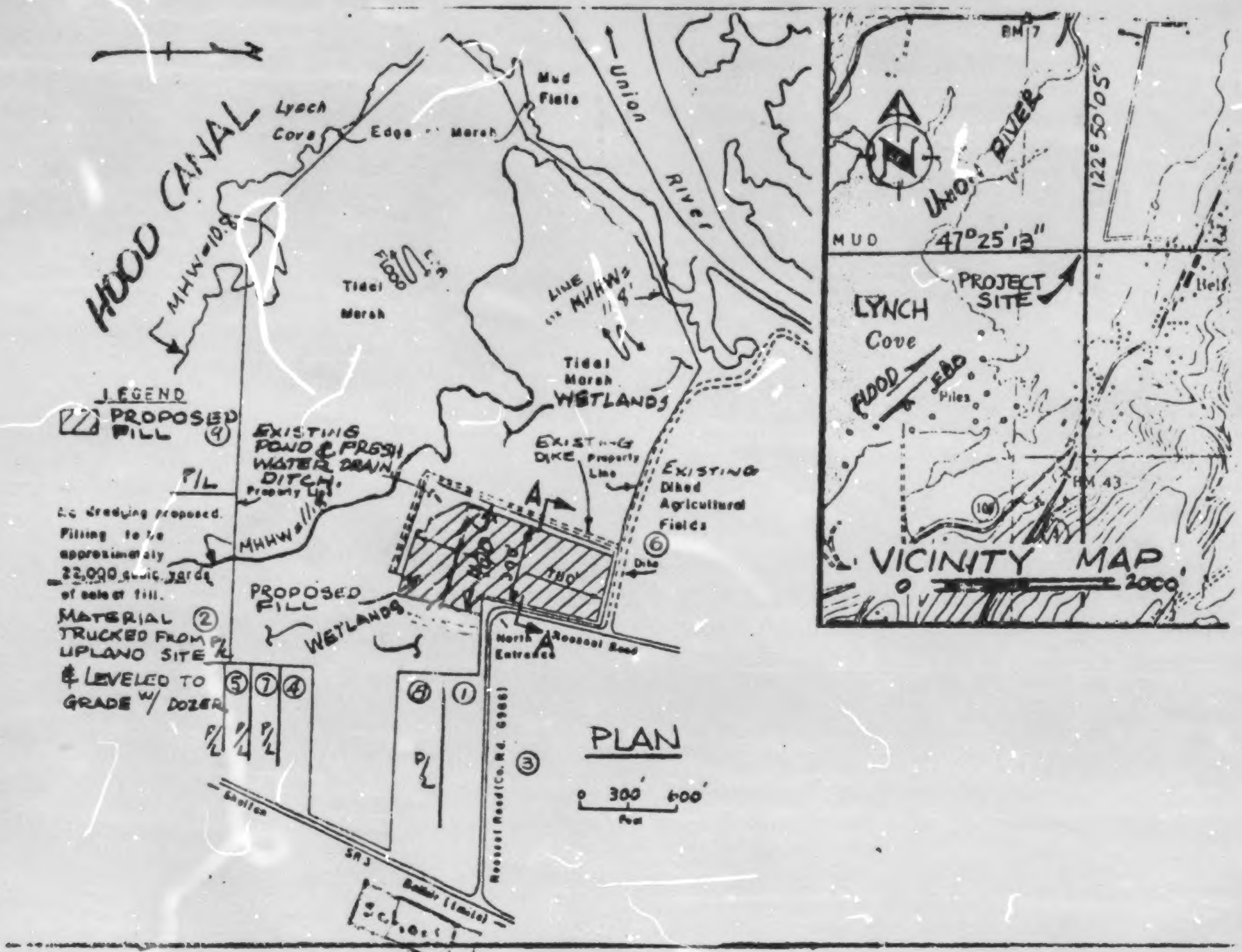
11-28 232

071-OYB-4-006602

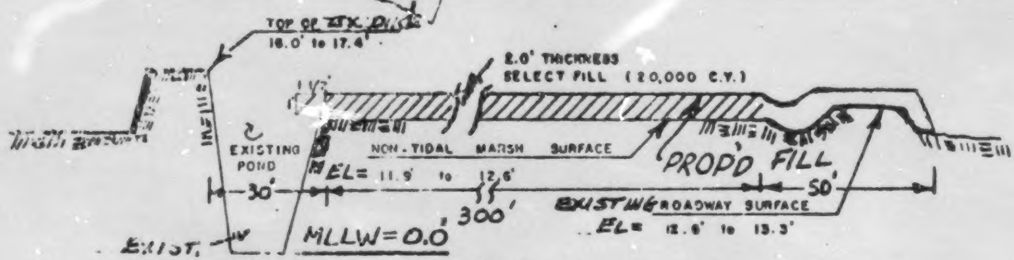
The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered; among those are conservation, economics, esthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people.

Comments on these factors will be accepted and made part of the record and will be considered in determining whether it would be in the best public interest to grant a permit. Comments should refer to the reference number shown above and reach this office, Attn: Permit Section, not later than 24 July 1980 to insure consideration.

1 Incl
Print (1)


HOOD CANAL
MHW=10.8
Lynch Cove
Edge of Marsh
Mud Flats
Union River
Tidal Marsh
FLOOD
LINE of MHHW 11.4'
Tidal Marsh
WETLANDS
LEGEND
PROPOSED FILL
EXISTING POND & FRESH WATER DRAIN DITCH.
Property Line
P/L
No dredging proposed. Filling to be approximately 22,000 cubic yards of select fill.
MATERIAL TRUCKED FROM UPLAND SITE & LEVELED TO GRADE w/ DOZER
MHHW
PROPOSED FILL
WETLANDS
EXISTING DIKE
Property Line
EXISTING Diked Agricultural Fields
Dike
A
North Entrance
Roessel Road
Roessel Road (Co. Rd. 6980)
Shelton
SR 3
Belfair (1 mile)
④ ② ⑤ ⑦ ④ ⑧ ① ③ ⑥
0 300' 600'
Feet
VICINITY MAP
0 2000'
N
UNION RIVER
MUD
47°25'13"
122°50'05"
BM 7
LYNCH Cove
PROJECT SITE
HOOD CANAL
EBB
Piles
BM 43
106
Belf

PLAN


TOP OF EX. DIKE
16.0' to 17.4'
2.0' THICKNESS
SELECT FILL (20,000 C.Y.)
EXISTING POND
NON-TIDAL MARSH SURFACE
EL= 11.9' to 12.6'
PROP'D FILL
30'
300'
50'
EXISTING ROADWAY SURFACE
EL= 12.6' to 13.3'
MLLW=0.0'
EXIST. FRESH WATER DRAINAGE DITCH

SECTION AA

Scale · Horizontal · 1" = 50' 0 10' 20' 30' 40' 50'

Vertical · 1" = 15' 0 5' 10' 15'

071-0YB-4-006602

PROPOSED: FILL

LYNCH COVE HOOD
IN CANAL, PUGET SOUND
NEAR BELFAIR
COUNTY OF MASON STATE W
APPLICATION BY NORTH MASON
CO. SCHOOL DIST. # 403
SHEET OF DATE 1 MAY

PURPOSE SCHOOL PLAYGROUND DEVELOPMENT

DATUM MLLW = 0.0 (N.O.S.)

ADJACENT PROPERTY OWNERS:

① Ben F. Austin
② Howard E. Barrow
③ Jerry D. & Cheryl Byerly
④ Reid L. Mitchell
⑤ Irvin D. Mosier
⑥ Jack F. Roessel
⑦ Jack H. Thompson
⑧ Bruce M. Whitman
⑨ Roy W. & Carol J. Wolf

3

11-30 234

How Effective are Environmental Action Campaigns?

Chapter 12
Activity Sheets

SAVE

Activity Packet 12

Prospective Study

1. Find an environmental issue in your community that needs your participation. Is a marsh about to be filled in? Is the speed limit for automobiles about to change?

2. Read all you can about the issue. Visit the concerned government offices to find out the rules and regulations that are involved with the environmental project. Interview persons who stand to gain and persons who stand to lose as a result of the action.

3. Evaluate what you have learned by your investigation. Then take a position on the issue - a position you strongly believe in. Join or organize a group of activists who wish to take action in support of their position.

4. Participate as actively as you are able in a campaign to effect the kind of change you believe is best. Keep a complete record of notes on readings, interviews, and activities.

SAVE

Activity Packet 12

Retrospective Study

1. Identify an environmental issue that was hotly debated in your community within the past 20 years. Biology teachers, government officials concerned with environmental matters, and news reporters can probably get you started.

2. Go to your newspaper office and read articles that reported on the issue. Interview persons mentioned in the article who were involved. Find out as much as you can about the circumstances of the times.

3. Review the actions taken by the groups that were involved in trying to prevent or cause change.

4. Evaluate the actions of the group. Did they campaign wisely? Were their tactics ethical? What did they do well? What did they do poorly?